A MODEL FOR PROVIDING PRELIMINARY COST ESTIMATES FOR MINOR PUBLIC WORKS PROJECTS.

John James Gallen

A MODEL FOR PROVIDING PRELIMINARY COST ESTIMATES FOR MINOR PUBLIC WORKS PROJECTS

by

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by ____________________

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A Model for Providing Preliminary Cost Estimates for Minor Public Works Projects

Thesis directed by Associate Professor Phillip F. Ostwald

The cost estimating model developed in this thesis was based on an in-depth analysis of 191 public works projects from 25 different cities throughout the United States. Twelve construction categories were selected into which all of the available data was distributed so that similar items can be meaningfully compared.

A basis of December 1969 was established and indexes for projected costs and geographical differences were developed that facilitated the analysis and correlation of project cost data. A series of base cost curves were then developed that portray the in-place cost trends for each of 55 construction items within the twelve categories.

With these cost curves and the indexes developed for geographical and projected cost differences, the estimator is able to develop preliminary cost estimates for minor public works projects in less than three hours, using only basic quantity input data. After having developed a facility for using this estimating tool the user can expect an estimating accuracy of ±15%.

The system also provides for the periodic updating of indexes and factors to keep the model current.

Signed Phillip F. Ostwald

Phillip F. Ostwald

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CHAPTER I

COST ESTIMATING DEVELOPMENT

Estimates have been prepared for public works projects since the earliest civilizations. The first estimates were probably nothing more than guesses as to the outcome of some future tasks. However, as more and more projects, jobs and tasks were completed, more and more information as to actual quantities, times and costs utilized in each project became available. This known data soon became the foundation upon which estimated costs for future projects were based.

Nevertheless, no matter how carefully the estimator was in choosing his data, there was usually some deviation between his estimated cost and the actual final cost. Lyle, et al,[1] quantifies this error in terms of the ratio of estimated to actual costs in projects of similar scope.

In one of his earlier papers on cost estimating, Doyle[2] related estimating accuracy to the number of elements into which the project was divided in the preparation of the cost estimate. While it stands to reason that the greater the number of segments into which a project can be divided, the greater the accuracy

of the estimate, the cost of making such a detailed study may not be so obvious. The cost associated with estimating errors was found by Doyle to decrease rapidly as the number of elements increased, while the costs associated with making the estimate increase in a linear fashion.

Hackney[3] and Doyle[4] both exhort the analysis of past estimates and costs to improve future estimates, but both are careful to point out that these estimates must coincide in degree of accuracy, if they are to be meaningfully compared. An estimate for a project in the million dollar range cannot be compared to those whose values are less than \$200,000, nor can single element estimates be realistically compared to multi-element estimates. There must be as sound basis for comparison.

Since the turn of the century, various indexes have been compiled that trace the cost of nearly every element involved in construction as these costs have risen over the years. These indexes, besides being indicators of inflationary or deflationary trends, also provide insight into technology changes and improvements in methods. However, with the wealth of information available in one form or another, little has been done towards assembling the various indexes into a format that could be readily applied.

The first phase of this thesis, therefore,

involves researching existing indexes, and establishing new indexes and factors that can be readily applied to the various elements of construction projects in the range of up to $200,000.

Detailed cost estimating is a very time consuming endeavor, resulting in a precision that is essential for projects that have been approved and funded and will be accomplished in the near future. However, there are instances when an estimator will be asked to provide a cost value for projects that may be little more than an engineering conceptual plan or a proposed function. To spend an inordinate amount of time attempting to ascertain a cost value for the poorly defined elements of these conceptual plans is not an economically justifiable endeavor.

There are occasions when the Public Works Officer or Base Engineer at a military installation will be called upon to estimate the costs of a potential project that may never even be approved for construction. Were he or his staff to spend many hours researching the project and amplifying the information, he would arrive at a reasonably close approximation of the actual cost of the project when and if it is built. Unfortunately, his schedule is usually so demanding that he cannot afford to spend an inordinate amount of time searching for cost data on projects whose eventual funding may be in doubt. However, he cannot ignore

these requests for estimates or merely render lip service to these requests. He must have at his disposal some means by which he can satisfy these requests with only a moderate amount of time being expended.

Accordingly, the second phase of this thesis involves the formulation of cost models which, when used in conjunction with the indexes developed, will form a readily useable process for estimating minor public works projects. It is intended that these projects can be quickly estimated with the assurance that the estimate will be accurate to a reasonable degree.

CHAPTER II

PROJECT COST ESTIMATES

The initial project submittals for the repair, minor construction and improvement portions of the Navy Military Construction Program is generally provided at the individual command or activity level. Using the Basic Facilities Requirement List (B.F.R.L.) as a guide, each military installation strives to achieve the maximum degree of material readiness by initiating projects that will eliminate identified deficiencies.

After each project is identified and an initial estimate has been provided, it is submitted to both the Engineering Field Division (E.F.D.) and the sponsor command for review and approval. The E.F.D. is responsible for the technical review. If the project is valid (the project purpose is to eliminate an identified deficiency or to directly support a newly assigned mission function) and its cost is considered reasonable, it is forwarded to the sponsor command of the activity with appropriate endorsement.

Each of the 17 sponsor commands then review all projects submitted by their subordinate activities and determine the priority for each project and the

order in which they shall be approved. Projects over $200,000 require the approval of the Secretary of the Navy or Congress, depending upon the nature and scope of the work involved. However, the majority of the projects submitted are in the $10,000 to $200,000 cost range and are in categories that may be approved and funded at the sponsor command level.

Considering the number of projects submitted each year and the paucity of funds available for the facilities programs, there are relatively few projects approved and funded each year. Consequently, less urgent projects may remain on priority lists for several years. Some will eventually be deleted from these lists as missions, programs and command functions change over the years.

In light of the above brief description of the manner in which projects are initiated, reviewed, and approved, it is reasonable to assert that detailed cost estimating for initial project submittals are neither required nor justified. Only when projects approach the top of the priority lists and are given a reasonably good chance of being approved and funded in the next year, should a more detailed and refined estimate be prepared.

The initial project idea given to the Public Works Officer may be as roughly defined as gross square feet of office area, or a 200 man barracks. To prepare

the project for submittal, he must first translate these given parameters into estimated units of basic construction category material from which the facility is built. The experience and judgement of Public Works departments, coupled with the NAVFAC (Naval Facilities Engineering Command) guidelines on basic facilities categories, enables these departments to arrive at a general idea as to required construction units.

The task of determining the estimated cost for a project is more involved. Geographical differences, inflation, labor and materials availability play a part in making cost estimating a difficult and time consuming operation. Were a readily useable guide available to assist the Public Works Officer in arriving at these estimates, his task would be simplified and more project estimates could be provided in a shorter time period. A process would also be useful during pressing periods near the end of the fiscal year when funds become available and previously drafted projects must be brought up to date in both scope and cost.

CHAPTER III

HISTORICAL ANALYSIS

As stated in the preceding chapter, the purpose of this thesis is to devise a useable system with which reasonable and accurate project estimates can be provided in a relatively short time, using limited information. In order for a system of this type to be applicable for projects throughout the country, input data from many and varied activities was required. In early February of this year letters were sent to 27 Resident Officers in Charge of Construction (ROICC) and Public Works Officers in different parts of the country, asking for cost data on completed projects in the $10,000 to $200,000 range. A sample letter is shown as Exhibit 3-1.

Of the twenty-five replies received, cost data for 191 completed or in-progress projects were distributed as follows:

Dollar Value (X 1000)				
10-25	25-50	50-100	100-200	200-
59	40	42	30	20

In each case the data submitted were copies of the "Schedule of Prices" a contractor is required to submit prior to proceeding with the actual construction of a

Exhibit 3-1

UNIVERSITY OF COLORADO
NAVAL RESERVE OFFICERS' TRAINING CORPS
BOULDER, COLORADO 80302

16 February 1973

LCDR Frederick S. Hall
Resident Officer in Charge of Construction
Northern Division NAVFAC Contracts
Naval Submarine Base New London
Groton, CT 06342

Dear Spence,

This letter is no different than others you may have received in the past from fellow CEC officers seeking data for a Master's degree project.

In order to gather sufficient information to complete my thesis, which involves a generalized approach to estimating minor public works projects, I am in need of certain project data from ROICC's throughout the country.

The information desired is that which the contractor is required to provide in his submittal of a schedule of prices. Having been a ROICC (Great Lakes, OCT 68 - APR 70) I am familiar with the total price make-up of the items on these documents, as well as the tendency on the part of the contractor to have a heavy hand when pricing early-completion items. I am looking for unit cost breakdowns in such categories as: electrical, mechanical, earthwork, carpentry, painting, concrete or masonry, etc. The variance in detail from project to project is not important, nor is the timeframe (anything up to five years old is good). However, if there are any unusual aspects of the job, an explanatory note would help.

Therefore, if you could send me copies of a half dozen or more schedules of prices from projects in the $10,000 - $200,000 range, I would greatly appreciate the assistance.

As I am asking for this information from ROICC's in various sections of the country, it is necessary to resort to this form letter in order to keep the costs down. I'm sure you'll understand.

Those of you who know me must realize that my coming to Colorado was no accident. Camping is great, skiing is even better and the country is beautiful. What the CEC needs is a dozen or so billets here. I'd be the first to volunteer!

Thanks again for your help.

Sincerely,

John

J. J. GALLEN, JR.
LCDR, CEC, USN

project. From these documents the following information can be obtained:

a) Geographical area
b) Date of award
c) Total contract price
d) Type of work
e) Range of bids
f) Unit price
g) Labor and material costs

A sample schedule of prices is included as Exhibit 3-2.

As required by the general provisions of the contract, each of the unit prices indicated on the schedule of prices include a prorated distribution of the contractor's entire amount of overhead and profit. The general practice of ROICC's is to allow as 25% markup for overhead and profit in negotiating change orders. This markup is assumed to exist in all unit price figures submitted on the schedule of prices. Care must be taken by ROICC's in approving these submittals as contractors tend to inflate the prices of work items to be completed first and deflate later ones in order to acquire a large working capital as soon as possible. When these practices are recognized the forms are returned to the contractor for a more equitable readjustment of the figures. Little evidence of these practices was found in analyzing the 191 forms received for this thesis.

The information received from the ROICC's provided cost data from projects of varied scope, and magnitude from many areas. This diversity of costs, scope, size and geographical area were important as they

Exhibit 3-2

SCHEDULE OF PRICES
PUBLIC WORKS CONTRACT - BUREAU OF Y...S AND DOCKS
NAVDOCKS 83 (REV. 8-63)
0104-800-0401

1. ACTIVITY AND LOCATION

Charleston Naval Shipyard, Charleston, S.C.

2. TITLE OF CONTRACT AND SITE LOCATION

Enlarge Elec. Manhole "B", Provide New Elect. Duct Bank, Charleston, S.C.

3. NAME AND ADDRESS OF CONTRACTOR

Wiggins Electric Co., Inc., P.O. Box 6094, North Augusta, S.C. 29841

4. CONTRACT NBR	5. DATE OF CONTRACT	6. CONTRACT PRICE	7. 2ND LOW BID*	8. HIGH BID*	9. NO. OF BIDDERS*
73-C-0100	8 Nov 72	22,928.17	31,413	43,233	7

10. ALLOTMENT OR ALLOCATION NO.	11. APPROPRIATION TITLE
	17X4912.2415

12. TIME FOR COMPLETION (Days)	13. SIGNATURE AND TITLE OF CONTRACTOR'S AGENT
120	G.C. Wiggins, Jr., President G. C. Wiggins

14. REVIEWED & FORWARDED (Date)	15. SIGNATURE OF APPROVING OICC

16.

a. ITEM NO.	b. DESCRIPTION OF ITEM	c. QUANTITIES: NO. OF UNITS	c. QUANTITIES: UNIT	d. MATERIAL COST: UNIT COST	d. MATERIAL COST: COST	e. LABOR COST: UNIT COST	e. LABOR COST: COST	f. TOTAL COST
1	Cutting Asphalt	25	sq.ft.	1.25	31.25	10.50	262.50	293.75
2	Sawing Concrete	70	Lin.ft.	3.00	210.00	10.50	735.00	945.00
3	Evacuation	161	Cu.Yd.	-	-	5.75	925.75	925.75
4	Demolition of Duct.	19	Cu.Yd.	25.00	475.00	32.00	608.00	1083.00
5	Shoring	450	sq.ft.	1.00	450.00	.50	225.00	675.00
6	Pilings	11	ea.	153.00	1683.00	11.50	126.50	1809.50
7	Forming	640	sq.ft.	1.25	800.00	.65	416.00	1216.00
8	Inst. of Pipe	1800	Lin.ft.	3.75	6750.00	2.08	3744.00	10494.00
9	Pour Concrete	53	Cu.Yd.	27.00	1431.00	12.50	662.50	2093.50
10	Backfill & Tamp.	127	Cu.Yd.	3.75	476.25	5.35	679.45	1155.70
11	Steel	2	Tons	559.00	1118.00	506.00	1012.00	2130.00
12	Clean up	1	All	-	-	106.97	106.97	106.97
					13424.50		9503.67	22928.17

enabled the cost estimating system to be founded on a broad base, thereby rendering it applicable to a wide range of projects.

CHAPTER IV

DETERMINING THE MODEL

To establish a model, the 191 projects were reviewed as to type of project and nature of the work involved. This review resulted in a requirement for twelve distinct contruction categories which, if utilized totally or in part, would be sufficient to provide cost estimates for nearly any type of public works project in the range specified. These categories, their composition and the basic units of measure are shown in Table 4-1.

From the project data provided, a series of twelve categories of graphs were derived. The estimator should then be able to enter each graph with an estimated quantity and obtain an expected base cost for that particular item. Having arrived at the expected base cost figures for all the items in a particular construction category, the user will then make adjustments for geographical variances through the use of tabulated indexes, developed for each category. Adjustments for seasonal variances must be made at the discretion of the user. Adjustments should be deferred until the project is actually approved since at the time of the initial

Table 4-1
Twelve Construction Categories

Basic Units of Measure	Category Number and Composition
cu yds	(1) Foundation (excavation, concrete, compacted fill)
tons, cu yds, board feet	(2) Structural (steel, concrete, wood framing)
sq ft	(3) Flooring (resilient tile, carpet, plywood, ceramic tile, accoustical tile)
sq ft	(4) Walls (brick, CMU, drywall, insulation)
sq	(5) Roofing (removals, shingle, built-up roofing)
sq ft	(6) Finishes (vinyl, exterior painting, interior painting)
each, sq ft	(7) Doors and Windows (doors and frames, aluminum windows, window glass, toilet partitions)
each, ft	(8) Plumbing (fixtures, manholes, pipe)
capacity, lbs, each	(9) Mechanical (boilers, AC equip., fans, ductwork, grilles)
ea, ft, capacity	(10) Electric (fixtures, receptacles, wire, conduit, panels, xformers)
ea	(11) Specialities (fire alarms, sprinklers)
SF, SY, LF, SY	(12) Exterior (sidewalks, paving, curbs and gutters, fencing, seeding)

project submittal it is virtually impossible to predict the season in which the project will be accomplished.

After all of the applicable category costs have been calculated as described in the subsequent paragraphs their sum is to be adjusted by the projected cost index for the anticipated time of construction.

The final step in determining the project cost involves inclusion of factors for:

a) contractor overhead and profit

b) a contingency which allows for not only limited alterations to scope prior to project funding but also modifications that occur in both the detailed project estimate and post award changes.

In the evaluations of the 191 projects utilized in establishing the estimating system, a flat figure of 25% was assumed for overhead and profit, as indicated in the previous chapter. No allowance for contingencies was considered to have been included in the projects submitted as the figures indicated reflect the actual award price of the contracts, with all pre-award modifications having already been included. A 5-6% allowance for contingencies at the initial project submittal stage will usually drop to about 1% when the project is approved for implementation.

The Cost Estimating Model, therefore, takes on

the following form:

$$C_i = \sum_{j=1}^{n} C_{ij}$$

where C_i = base cost of category i; i = 1,12

C_{ij} = individual cost elements of a category

j = 1,n (from graphs)

$$C_{ig} = C_i \left(\frac{Ig}{100}\right)\left(\frac{Is}{100}\right)$$

where C_{ig} = total geographical cost for category

I_g = geographical index for category

I_s = seasonal index for category. Is = 100 unless user has other information available.

$$T.C._{b.} = \left(\frac{Ip}{100}\right) \sum_{i=1}^{12} C_{ig}$$

where $T.C._{b.}$ = total base cost

I_p = projected construction cost index

and finally

$$T.P.C. = TC_b \text{ (FOP) (Fc)}$$

where T.P.C. = total project cost

Fop = overhead and profit factor

Fc = contingencies factor

CHAPTER V

ESTABLISHING THE BASIS

In order for any system of indexes to be useful and meaningful, there must be established a reference point upon which to base all computations. This was the situation in attempting to formulate the estimating model. All major factors contributing to the projects under consideration were analyzed and weighed in the course of formulating a prime index upon which to base all future calculations.

The first step in the establishment of the basis was the determination of a base year and month. Many commercial indexes are published that relate to construction and industrial building. Each generally has a different base year and each considers certain segments of the construction industry.

By scanning a rough sketch of each of the trends of these indexes, it became apparent that in December 1969 there began a noticeable upward sweep in nearly all the indexes. In order that the proposed estimating system be founded on a sound base that would reflect the beginnings of a pronounced inflationary trend, December 1969 was selected as the base month. This selection

allowed nearly all of the data from the 191 projects to have a base of greater than 100, and simplified later calculations.

Using the guidelines introduced by Patterson[5] and Orr[6], data and indexes such as those formulated by the major engineering periodicals such as Engineering News Record were adapted to the particular estimating methods employed by Navy Public Works Officers.

Thirteen major commercial construction indexes[7,8] spanning from 1969 to 1972 were each converted to December 1969 as a base of 100 and were plotted on a graph as shown in Figure 5-1. The average slope was considered a reliable estimate of construction industry cost trend for the time period under consideration. Intermediate points were interpolated for use as necessary when project data were being analyzed.

Figure 5-2 is a projected curve which was developed by the least squares method using converted index data through June 1973.[9] Another method of determining a future index would be to take any of the thirteen commercial indexes used in Figure 5-1, convert to a December 1969 = 100 base and compare it to the projection of the composite curve. The Turner, Campbell, and American Appraisal Indexes seemed to more closely follow the composite index than did the others.

With a basis established, it was next necessary to determine how this basis could be expected to vary

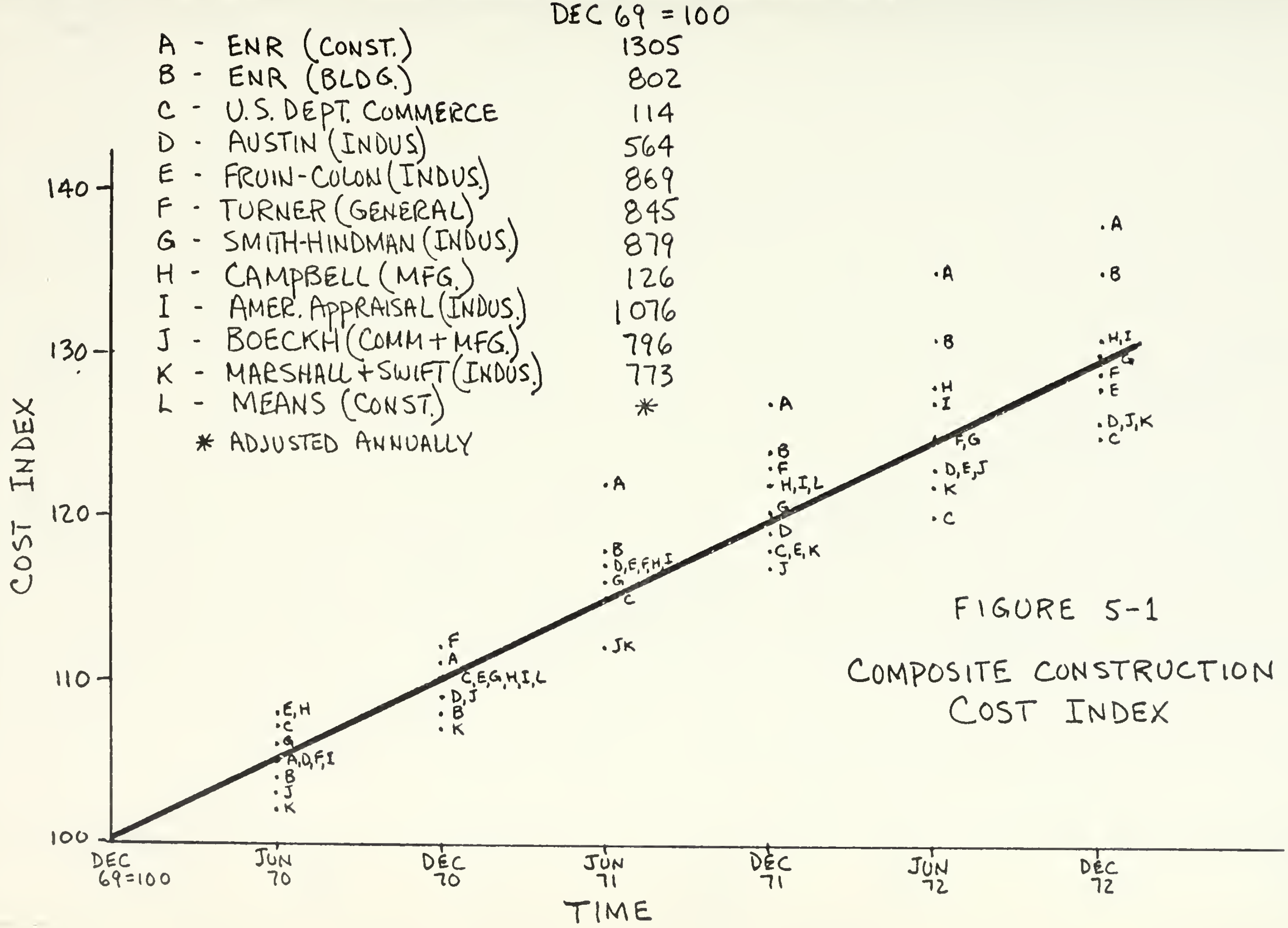

FIGURE 5-1

COMPOSITE CONSTRUCTION COST INDEX

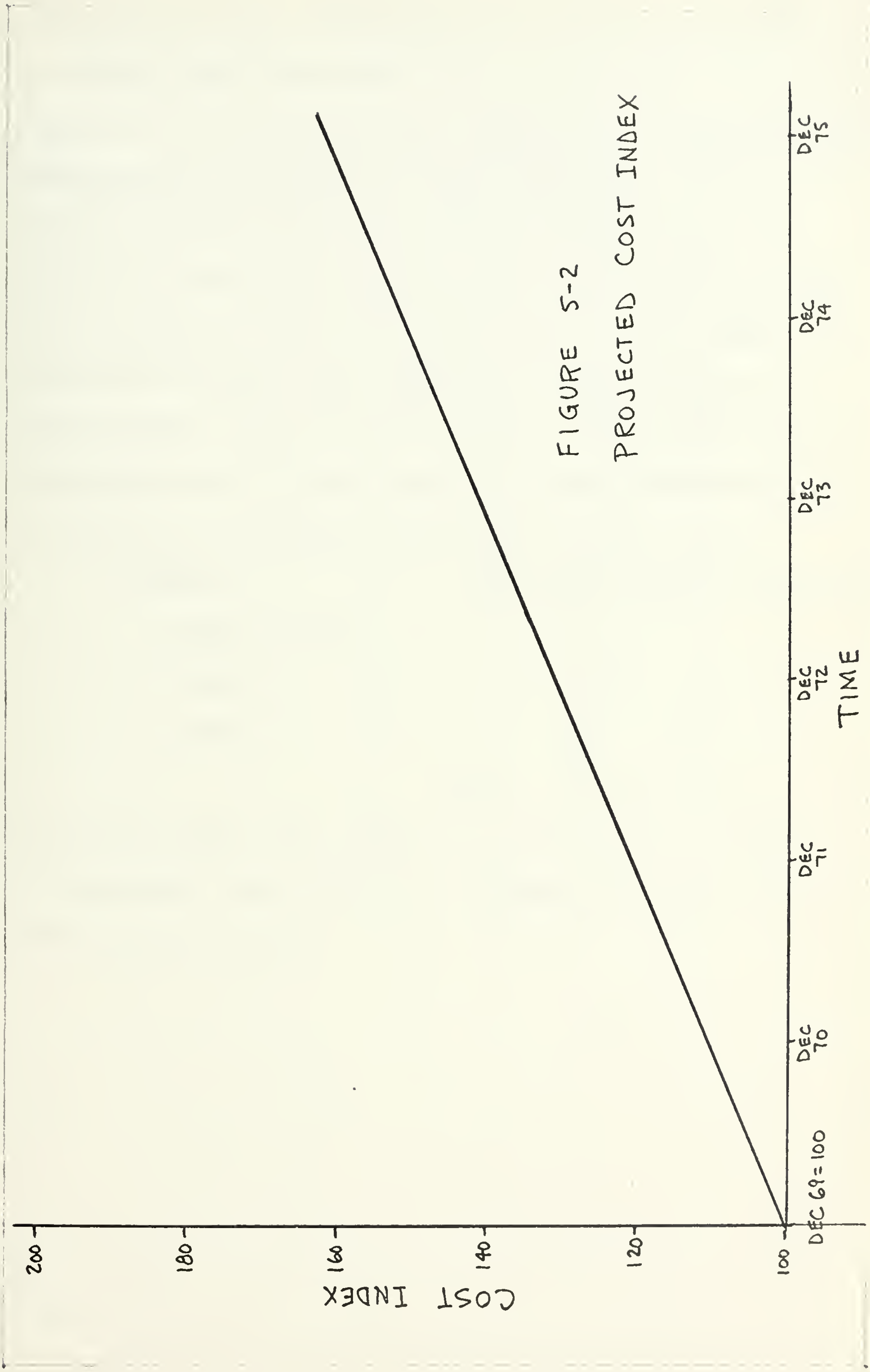

FIGURE 5-2
PROJECTED COST INDEX

from city to city. Information of this sort is compiled by several major companies. The two who seem to be most prominent in the construction industry are <u>Means Building Construction Cost Data</u> and <u>Engineering News Record</u>. The relative construction cost indexes for each of twenty cities was developed by taking both the Means[10] and ENR[7] cost indexes of each of twenty cities for the years 1971 and 1972, setting their composite average equal to 100 and averaging the figures for each of the twenty cities. The nearest whole number figure was then determined to be the relative general cost index for each city.

Example:	For Index City #1 (Atlanta)
Means 71-72	93
ENR 71	87
ENR 72	91
Total	$271 \div 3 = 91$

The whole number Cost Index for City #1 is 91. Table 5-1 tabulates these City Cost Indexes for each of the twenty major cities.

Table 5-1
City Cost Indexes (Adjusted to 100 Average Base)

City	City #	Means 71-72	Engr 71	Engr 72	Average
Atlanta	1	93	87	91	91
Baltimore	2	97	98	99	98
Birmingham	3	84	83	86	84
Boston	4	103	100	96	101
Chicago	5	104	101	105	103
Cincinnati	6	105	103	103	103
Cleveland	7	113	110	108	110
Dallas	8	87	85	89	87
Denver	9	91	95	95	94
Detroit	10	113	110	109	111
Kansas City	11	95	96	101	97
Los Angeles	12	100	97	105	103
Minneapolis	13	102	99	97	99
New Orleans	14	93	84	85	87
New York	15	116	120	117	118
Philadelphia	16	100	106	106	104
Pittsburgh	17	106	109	109	108
St. Louis	18	103	95	97	98
San Francisco	19	107	107	110	108
Seattle	20	95	86	89	90

CHAPTER VI

GEOGRAPHICAL INDEX FORMULATION

To reduce the various project data to comparable quantities, a geographical index, encompassing the relative contributions of labor and material, had to be developed for each of the twelve construction categories for each city.

This index was developed in four phases:

a) Development of trade wage index

b) Development of material cost indexes

c) Determination of the relative contribution of labor and material for each category

d) Blending the labor and material indexes into a single geographical index for each city and category.

The individual trade wage indexes were calculated in the following manner. The Engineering News Record and the Bureau of Labor Statistics publish current wage rates for major trades on a monthly basis, although little change is seen in any of these wage rates over the course of a year, depending on when a particular wage contract has been negotiated. Therefore, actual wage

costs for each trade were available for each city under consideration.[7,8]

The average wage rate for each trade was taken and multiplied by the previously calculated general cost index for each of the twenty cities under consideration. The resulting figures represent the expected wage rate for each trade in each city.

By setting these expected wage rates as a base equal to 100 for each trade and city, a comparison with the actual wage rates was made. The resulting figure is the individual trade wage index for each city.

Example: For Index City #1(Atlanta)

Common Building Labor

Base Wage Rate	=	\$6.86/HR.
General Cost Index	=	.91
Expected Wage Rate	=	\$6.24/HR.
Actual Wage Rate	=	\$4.90/HR.

$$\frac{490}{6.24} = .79$$

The Trade (Common Labor) Wage Index for City #1 is 79. This procedure having been followed for eleven major trades over the twenty cities, a general schedule of trade wage indexes was developed as shown in Table 6-1.

The individual material indexes for each city were calculated in much the same way as were the wage indexes. The general cost index for each city was applied to current twenty city average prices or average

Table 6-1
Calculation of Labor Indexes for Local Trade Variances

	Lab	Cem Fin	Paint	Mason	Carp	Elec	Equip Op	Trk Drvr	Plumb	Roofer	Iron Wkr
Base Rt.	6.86	8.69	8.06	9.42	8.86	9.70	9.00	6.66	10.04	8.22	9.55
City #/ Geo. Ind.											
#1 - 91	*4.90 79	7.38 93	6.68 91	8.46 98	8.12 101	9.90 112	7.05 85	5.15 85	8.70 95	7.01 88	7.52 87
#2 - 98	5.87 87	8.26 97	7.72 98	9.57 104	8.65 100	8.82 93	8.50 96	5.96 91	9.05 92	8.05 100	9.02 96
#3 - 84	4.93 86	6.67 91	6.23 92	7.53 95	6.87 92	7.82 96	7.23 96	5.13 92	8.66 103	6.94 93	8.29 103
#4 - 101	7.30 105	8.60 98	8.42 103	9.54 100	8.81 99	10.38 106	9.86 108	5.66 84	10.00 99	8.50 102	9.21 95
#5 - 103	7.62 108	9.39 105	8.78 106	9.94 102	9.81 108	9.99 100	9.42 102	6.70 98	9.99 97	8.92 105	10.90 111
#6 - 103	8.15 115	9.66 108	9.03 109	9.90 102	9.70 106	9.63 97	9.74 105	5.99 87	10.27 100	9.28 110	9.99 102
#7 - 110	9.00 119	9.50 99	9.25 104	10.49 101	10.44 107	10.48 98	10.30 104	5.85 80	10.53 95	9.03 100	10.43 99
#8 - 87	5.23 88	7.12 94	6.65 95	8.07 99	7.59 98	7.82 93	7.52 96	3.45 62	8.52 98	6.86 96	7.47 90

Table 6-1 (Continued)

	Lab	Cem Fin	Paint	Mason	Carp	Elec	Equip Op	Trk Drvr	Plumb	Roofer	Iron Wkr
#9 - 94	5.25	7.97	7.45	9.65	7.52	8.64	6.50	5.60	9.10	7.50	8.39
	82	98	98	109	90	95	77	89	97	97	93
#10- 111	8.25	10.08	9.42	10.59	10.22	11.17	9.48	7.95	11.00	9.78	11.24
	108	104	105	101	104	104	95	108	98	107	106
#11- 97	6.69	8.19	7.65	8.63	8.57	9.60	10.10	7.38	9.26	7.88	9.85
	100	97	98	95	100	101	116	114	100	99	106
#12- 103	7.55	9.45	8.53	10.11	8.90	10.78	10.08	8.64	11.54	8.84	10.87
	107	106	103	104	98	108	109	126	111	104	110
#13- 99	7.00	8.38	7.83	8.68	9.11	9.28	8.08	6.70	9.11	8.06	8.55
	103	97	98	93	104	96	91	102	92	99	90
#14- 87	5.11	6.84	6.39	7.69	7.31	8.29	7.52	5.70	8.73	6.53	7.67
	86	90	91	94	95	98	96	98	100	91	92
#15-118	8.81	11.26	10.52	12.24	11.09	12.67	10.83	9.19	11.12	10.83	12.25
	109	110	111	110	106	111	102	117	94	112	109
#16-104	6.85	9.25	8.40	9.96	10.17	10.07	9.43	6.29	10.57	8.87	10.54
	96	102	100	102	110	100	101	91	101	104	106
#17-108	7.13	9.17	8.57	10.01	9.71	9.97	9.94	6.53	10.16	8.81	9.92
	96	98	98	98	101	95	102	91	94	99	96

Table 6-1 (Continued)

	Lab	Cem Fin	Paint	Mason	Carp	Elec	Equip Op	Trk Drvr	Plumb	Roofer	Iron Wkr
#18- 98	7.85	8.51	8.39	8.94	8.79	9.93	8.77	8.22	10.80	8.43	9.31
	117	100	106	97	101	104	99	126	110	105	99
#19- 108	7.79	9.63	9.44	11.09	10.03	9.82	10.67	8.31	12.07	9.55	10.87
	105	103	108	109	105	94	110	116	111	108	105
#20- 90	6.10	7.90	7.38	8.68	8.03	8.85	8.14	7.96	9.63	7.50	8.94
	99	101	102	102	100	101	100	123	107	101	102

*Top Line Entry is Actual Scale as of December 1972.

price indexes (whichever was available) for the major materials used in each of the twelve construction categories.[7,8] Sources of this information were primarily Engineering News Record and the Bureau of Labor Statistics. It made no difference whether the figures used were indexes or prices since each would ultimately be converted to a relative index. This method again yielded an expected price (or index) for each material for each city.

Setting these expected values as a base equal to 100 for each material and city, and comparing them to the actual price or indexes, yielded an individual material cost index for each material and city. Tables 6-2 Part 1 and 2 are the general schedule of material indexes developed for the 18 materials considered for each of the twenty cities.

Example: For Index City #1 (Atlanta)

Readimix Concrete

Base Material Index	=	134
General Cost Index	=	.91
Expected Material Index	=	122
Actual Material Index	=	125

$$\frac{125}{122} = 1.03$$

The Material (Concrete) Cost Index for City #1 is 103.

The next phase involved an analysis of the composition of each of the twelve construction categories to

Table 6-2 Part I
Calculation of Material Indexes for Local Variance

City #	Base Rate* / Geo. Ind.	Redimix Conc. 134 I	2x4 166 I	Plywood 200 I	Brick 55 P	Gyp. 70 P	CMU 32.4 P	Steel 477 P	Asph Roof 3.91 P	Doors Glass 127 I
1	91	125 103	154 102	165 91	46 92	60 94	27.1 92	452 104	4.26 120	137 118
2	98	154 117	181 111	212 108	59 109	71 103	31.7 100	470 100	3.33 87	135 109
3	84	120 108	153 110	203 120	38 83	64 108	27.1 100	444 111	4.22 129	135 126
4	101	155 116	165 98	240 119	68 122	68 96	32.7 100	472 98	3.77 96	133 104
5	103	122 88	127 74	202 98	41 72	85 118	38.4 114	490 100	4.00 100	117 89
6	103	137 100	189 110	162 75	55 97	83 109	24.9 75	488 100	4.35 108	115 88
7	110	94 84	170 93	210 95	59 99	79 102	26.0 73	496 95	4.00 93	131 94
8	87	125 107	159 110	144 83	41 86	42 69	24.5 87	449 108	4.05 119	119 108
9	94	93 89	145 93	211 113	38 73	65 99	33.5 110	467 104	4.37 119	131 110
10	111	131 88	140 76	173 78	49 81	44 77	39.6 110	499 94	4.08 94	110 78

Table 6-2 Part I (Continued)
Calculation of Material Indexes for Local Variances

City #	Geo. Ind.	Redimix Conc.	2x4	Plywood	Brick	Gyp.	CMU	Steel	Asph Roof	Doors Glass
11	97	136	154	238	58	65	36.2	478	4.51	125
		104	96	122	109	96	115	103	119	102
12	103	122	175	203	59	74	31.7	483	4.17	139
		88	102	98	103	102	95	98	103	106
13	99	107	140	174	70	65	32.7	474	4.95	104
		80	85	88	127	94	102	100	127	83
14	82	118	159	128	47	50	33.9	447	3.60	125
		100	110	74	109	82	110	108	106	120
15	118	145	169	207	65	74	30.5	518	3.50	131
		92	86	88	100	89	80	97	76	87
16	104	141	202	204	41	54	29.4	485	3.61	144
		101	116	98	72	74	87	98	89	109
17	108	132	172	260	44	74	33.9	4.98	4.12	108
		90	96	115	75	97	97	97	106	79
18	98	126	180	218	55	65	30.5	478	4.46	104
		96	110	111	102	110	96	102	116	84
19	108	124	169	197	72	60	33.9	493	4.05	147
		88	94	91	122	79	97	96	96	107
20	90	122	165	243	68	62	44.1	472	5.00	153
		102	111	135	137	98	127	110	132	134

Table 6-2 Part II
Calculation of Material Indexes of Local Variances

City #	Base Rate* / Geo. Ind.	Paint 117^{I}	Asph. $.143^{P}$	Sheet Metal 68.18^{P}	Pipe 111^{I}	Plumb Fixt. 120^{I}	Copper Wire 106^{I}	HVAC Equip 126^{I}	Elect Fixt. 130^{I}	General Material Index 128^{I}
1	91	116 109	.140 108	70.20 113	106 105	108 99	100 103	122 106	130 110	121 104
2	98	106 92	.180 129	84.30 126	126 116	107 91	87 84	135 109	124 97	132 105
3	84	109 111	.130 108	72.50 127	92 99	141 140	120 135	141 133	142 130	125 116
4	101	99 84	.140 97	65.27 95	112 100	126 104	108 101	127 100	134 102	132 102
5	103	114 94	.135 92	64.80 92	116 102	114 92	124 114	119 92	135 101	127 96
6	103	120 99	.145 99	64.89 92	109 96	127 96	120 110	122 94	133 99	128 97
7	110	132 102	.150 96	64.85 86	114 93	127 122	125 107	144 104	143 100	135 96
8	87	123 121	.124 100	64.15 108	100 103	109 96	94 102	112 102	119 105	112 101
9	94	134 122	.163 122	65.85 103	109 105	118 104	120 120	122 103	141 115	128 106
10	111	113 87	.200 126	64.68 85	130 106	94 71	105 89	109 78	120 83	125 88

Table 6-2 Part II (Continued)

Calculation of Material Indexes of Local Variances

City #	Geo. Ind.	Paint	Asph.	Sheet Metal	Pipe	Plumb Fixt.	Copper Wire	HVAC Equip	Flect Fixt.	Gen Material Index
11	97	120	.135	64.77	108	137	116	132	135	133
		106	97	98	100	118	113	108	107	107
12	103	137	.120	81.00	107	153	125	154	147	137
		113	82	115	94	123	115	119	110	104
13	99	116	.135	64.99	111	127	90	126	108	123
		100	95	96	101	107	86	101	84	97
14	82	113	.113	66.25	119	127	104	128	128	115
		118	97	118	131	130	120	124	120	110
15	118	105	.138	61.47	106	98	92	109	123	125
		76	82	76	81	69	74	73	80	83
16	104	111	.135	61.00	110	152	125	136	150	130
		91	91	86	96	122	114	104	111	98
17	108	127	.157	64.50	119	92	119	109	128	129
		101	102	88	99	71	104	80	91	93
18	98	122	.130	64.57	102	100	84	112	104	122
		106	93	97	94	85	81	91	82	97
19	108	113	.130	79.25	110	103	87	127	128	129
		90	84	108	92	79	76	93	91	93
20	90	116	.160	74.35	114	133	116	138	158	139
		110	124	121	114	123	122	122	128	121

*P indicates price; I indicates Index.

determine the degree to which each of the major trades contributed to each category. By this same logic, the material contribution relative to each category was also analyzed. Only the major trade and material contributions, previously considered, were utilized in the calculation of the relative weights to be assigned in both labor and material portions of this analysis. This twelve category analysis is indicated in Table 6-3.

A sampling of thirty of the 191 project data received was then analyzed to determine the relative unit proportions of labor to material that would be applied in establishing a single geographical index for each construction category. For the thirty projects reviewed, the distribution of ratios of labor to material is indicated in Table 6-4 as the number of items found to be in each particular ratio. This analysis merely set up an approximate whole number proportion by which labor and material indexes could be blended into a single multiplier for each category and each city.

Example: For Index City #1 (Atlanta)

Foundations

Labor/Material Ratio	=	3/1	
Labor Ratio	=	1/3 each	
		Indexes	
Truck Driver	=	85	
Equip. Operator	=	85	
Laborer	=	79	= 249

Table 6-3
Labor-Material Analysis of Construction Categories

Construction Category	Trades Involved	Labor Ratio	Materials Involved	Materials Ratio	L/M Ratio
1) Foundation	Truck Driver Equip. Oper. Laborer	1/3 ea	Concrete	1	3/1
2) Structural	Iron Worker Carpenter Laborer	1/3 ea	Concrete, Steel, Rebar	½ ea	1/2
3) Flooring	Carpenter Cement Fin. Laborer	2 C. 1 C. F. 1 L.	Plywood Concrete	1/ 2 ea	1/2
4) Walls	Mason Carpenter Laborer	1/3 ea	Plywood Brick CMU Gypsum 2x4's	1/5 ea	1/1
5) Roofing	Roofer Laborer	3 R. 1 L.	Asph. Roofing	1	2/1
6) Finishes	Painter Carpenter	½ ea	Paint Plywood	½ ea	3/1
7) Doors/ Windows	Carpenter Laborer	2 C. 1 L.	Doors Glass	1	1/6

Table 6-3 (Continued)
Labor Material Analysis of Construction Categories

Construction Category	Trades Involved	Labor Ratio	Materials Involved	Materials Ratio	L/M Ratio
8) Plumbing	Plumber	1	Pipe Fixtures	1 Pipe 2 Fixt.	1/3
9) H.V.A.C.	Plumber Electrician Iron Worker	1 P. 1 E. 3 I. W.	Equipment Ducting	½ ea	1/8
10) Electrical (Does Not Include Switchgear)	Electrician	1	Wiring Fixtures	½ ea	1/2
11) Specialities	Electrician Plumber Carpenter	1/3 ea	Average Material Index	1	1/3
12) Exterior	Laborer Conc. Fin. Equip. Op.	3 L. 1 C.F. 1 E. O.	Concrete Asphalt	½ ea	2/1

Table 6-4
Determination of L/M Ratios
for Types of Work

Type of Work	4/1	3/1	2/1	L/M Ratios 1/1	1/2	1/3	1/4*	Composite
Excavation	4							3/1
Concrete	1	2		1	2			
Steelwork				2	4			1/2
Conc. Slab.				1	1			1/2
Flooring			1	1	3	1		
Brickwork			2	3				1/1
Walls	1			1	1	1		
Roofing		1	3	1	1			2/1
Insulation			1	1		1		
Painting	3	3	3					3/1
Windows/Doors			1		4		10	1/6
Hardware								
C.I. Piping				1		3		
Copper "				2	1			1/3
Plumbing Fixt.					1		2	
HVAC Units				2	2		12	1/8
Ductwork								
Panels, Fixtures		1	1	2	2	1	2	1/2
Wiring, Conduit			2	1				
Sprinklers,			1	1	1	1		
Fire Alarms						1		1/3
Paving	1			2	2	1		2/1
Landscaping	1		6	3	2			
Fencing				1	1	1		

*¼ or less

Combined Labor Index		249 ÷ 3 = 83
Material Ratio	=	1
Concrete Index	=	103
83 x 3	=	249
103 x 1	=	103
		352 ÷ 4 = 88

The Foundations Labor/Material Index for City #1 is 88. Tables 6-5 Parts 1,2,and 3 indicate calculated Labor/ Material Indexes for each category and city.

Finally, by combining this single multiplier with the general cost index for each city (calculated in the previous chapter), a matrix arrangement of combined multipliers for each of the twenty cities was developed for each of the twelve construction categories.

Example: For Index City #1 (Atlanta)

Foundations

Labor/Material Index	=	88
General Cost Index	=	x.91
		80.

The Foundations Combined Multiplier for City #1 is 80. Table 6-6 is a matrix arrangement of these multipliers for each category and each city.

The single multiplier for each category and each city is the geographical index. Its application proved valuable in simplifying the calculation of the base cost charts in the following chapters. This matrix of

Table 6-5 Part 1
Labor/Material City Indexes

City #	(1) Foundations L/M=3/1			(2) Structural L/M=½			(3) Flooring L/M=1/2			(4) Walls L/M=2/1		
	L	M	LM1	L	M	LM1	L	M	LM1	L	M	LM1
1	83	103	88	89	103	98	94	97	96	93	94	94
2	91	117	98	94	108	103	96	112	107	97	106	102
3	91	108	95	94	109	104	90	114	106	91	104	98
4	99	116	103	100	107	105	100	118	112	101	107	104
5	103	88	99	109	94	99	107	93	98	106	95	100
6	102	100	101	108	100	103	109	88	95	108	93	100
7	101	84	97	108	90	96	108	90	96	109	107	108
8	82	107	88	92	107	102	95	95	95	95	87	91
9	83	89	85	88	96	93	90	101	97	106	98	102
10	104	88	100	105	91	96	105	83	90	104	84	94
11	110	104	108	102	103	103	99	113	108	98	108	103
12	114	88	107	105	93	97	102	93	96	103	100	101
13	99	80	94	99	90	93	102	84	90	100	99	100
14	93	100	95	91	104	100	92	87	89	94	98	96
15	109	92	105	108	94	99	108	90	96	108	89	98
16	96	107	97	104	100	101	105	99	101	103	89	96
17	96	90	95	98	93	95	99	103	102	98	96	97
18	114	96	110	106	99	101	105	104	104	105	106	106
19	110	88	105	105	92	96	105	90	95	106	97	101
20	107	102	106	100	106	104	100	118	112	100	122	111

Table 6-5 Part 2
Labor/Material City Indexes

City #	(5) Roofing L/M=2/1			(6) Finishes L/M=3/1			(7) Doors/Wind. L/M=1/6			(8) Plumbing L/M=1/3		
	L	M	LM1	L	M	LM1	L	M	LM1	L	M	LM1
1	86	120	97	96	100	97	94	118	115	95	101	99
2	97	87	94	99	100	99	96	109	107	92	101	99
3	91	129	104	92	110	95	90	126	121	103	127	121
4	103	96	101	101	101	101	101	104	103	99	103	102
5	106	100	104	107	96	106	108	89	92	97	95	96
6	111	108	110	108	87	104	109	88	91	100	96	97
7	105	93	101	105	98	104	111	94	97	95	112	108
8	94	119	102	97	102	98	95	108	106	98	98	98
9	93	119	102	94	118	102	87	110	107	97	104	102
10	107	94	103	104	83	98	105	78	82	98	83	87
11	99	119	106	99	114	103	100	102	102	100	112	109
12	105	103	104	101	106	102	101	106	105	111	113	112
13	100	127	109	101	94	99	104	83	86	92	105	102
14	90	106	95	93	96	94	92	120	116	100	130	122
15	111	76	99	108	82	102	107	87	90	94	73	78
16	102	89	98	105	95	102	105	109	108	101	113	110
17	98	106	101	100	108	102	99	79	82	94	81	84
18	108	116	111	103	108	104	106	84	87	110	88	93
19	107	96	103	107	91	103	105	107	107	111	83	90
20	100	132	111	101	122	106	100	134	129	107	120	117

Table 6-5 Part 3
Labor/Material City Indexes

City #	(9) HUAC L/M=1/8			(10) Electrical L/M=1/2			(11) Specialities L/M=1/3			(12) Exterior L/M=2/1		
	L	M	LM1	L	M	LM1	L	M	LM1	L	M	LM1
1	94	109	107	112	106	108	103	104	104	83	105	90
2	95	118	115	93	91	92	95	105	102	91	123	102
3	102	130	127	96	132	120	97	116	111	89	108	95
4	98	97	97	106	101	103	101	102	102	104	106	105
5	106	92	94	100	107	105	102	96	98	106	90	101
6	101	93	94	97	105	102	101	97	98	112	100	108
7	98	95	95	98	103	101	100	96	97	112	90	105
8	92	105	104	93	103	100	96	101	100	91	103	95
9	94	103	102	95	117	110	94	106	103	84	105	91
10	104	87	89	104	86	92	98	88	91	105	107	106
11	104	103	103	101	110	107	100	107	105	103	100	102
12	110	117	116	108	112	111	106	104	105	107	85	100
13	92	98	97	96	85	89	97	97	97	100	88	96
14	95	121	118	98	120	113	98	110	107	89	99	92
15	107	75	79	111	77	88	104	83	88	108	87	101
16	104	95	96	100	112	108	104	98	100	98	96	97
17	96	84	85	95	97	96	97	93	94	98	96	97
18	102	94	95	104	82	89	105	97	99	110	95	105
19	104	100	100	94	84	87	103	93	95	106	86	99
20	103	121	119	101	125	117	103	121	116	100	113	104

Table 6-6

Table of Combined Multipliers

City and City No.	1	2	3	4	5	6	7	8	9	10	11	12	*
Atlanta (1)	80	89	87	85	88	88	105	90	97	98	95	82	91
Baltimore (2)	96	101	105	100	92	97	105	97	113	90	100	100	98
Birmingham (3)	80	87	89	82	87	80	102	102	107	101	93	80	84
Boston (4)	104	106	113	105	102	102	104	103	98	104	103	106	101
Chicago (5)	102	103	101	102	107	109	95	99	97	108	101	104	103
Cincinnati (6)	104	103	98	106	113	107	94	100	97	105	101	111	103
Cleveland (7)	107	106	106	119	111	114	107	119	105	111	107	116	110
Dallas (8)	77	89	83	79	89	85	92	85	90	87	87	83	87
Denver (9)	80	87	91	96	96	96	101	96	96	103	97	86	94
Detroit (10)	111	107	100	104	114	109	91	97	99	102	101	118	111
Kansas City (11)	105	100	109	100	103	100	99	106	100	104	102	99	97
Los Angeles (12)	110	100	99	104	107	105	108	115	119	114	108	103	103
Minneapolis (13)	93	92	89	99	108	98	85	101	96	88	96	95	99
New Orleans (14)	83	87	77	84	83	82	101	106	103	98	93	80	87
New York (15)	124	117	113	116	117	120	106	92	93	104	104	119	118
Philadelphia (16)	101	105	105	100	102	106	112	114	100	112	104	101	104
Pittsburgh (17)	103	103	110	105	109	110	89	91	92	104	102	105	108
St. Louis (18)	108	99	102	104	109	102	85	91	93	87	97	103	98
San Francisco (19)	113	104	103	109	111	111	116	97	108	91	103	107	108
Seattle (20)	95	94	101	100	100	95	116	105	107	105	104	94	90

*Original Geographical Index (included in all other multipliers) - to be used for additional, unusual items.

NOTE: Columns 1 through 12 represent the 12 basic construction categories.

geographical indexes should also facilitate the application of this system by the estimator.

CHAPTER VII

BASE DATA GRAPH FORMULATION

With the geographical indexes available for use, the data from the 191 projects was reviewed in detail. All project cost elements were sorted into the twelve construction categories for individual analysis.

To have a useable construction cost index factor for each element, the graph developed in Figure 5-1 was interpolated so that a single index was provided for each month from December 1969 through February 1973. These indexes, listed in Table 7-1, together with the matrix of geographical indexes shown in Table 6-6, enabled the cost elements to be converted to base data from which base cost curves were developed.

The method used in converting project cost elements into base data consisted of the following:

A multiplier, denoted as "K", was developed for each element by dividing:

a) 1.0 by 1.25, to eliminate allowances for overhead and profit

b) The quotient of that operation by the decimal equivalent of the geographical index, to remove any area influences

Table 7-1
Interpolated Values of
Cost Index Projections (Ip)*

Month	1969	1970	1971	1972	1973
January	-	100.8	110.8	121.3	130.3
February	-	101.7	111.6	122.2	131.1
March	-	102.5	112.4	123.0	-
April	-	103.3	113.3	123.8	-
May	-	104.2	114.1	124.6	-
June	-	105.0	114.9	125.4	
July	-	105.9	115.7	126.2	
August	-	106.7	116.5	127.0	
September	-	107.5	117.4	127.9	
October	-	108.4	118.4	128.7	
November	-	109.2	119.5	129.0	
December	100.0	110.0	120.5	129.5	

*This Table was derived merely to facilitate the conversion of project cost data to base data.

c) The resulting figure by the decimal equivalent of the cost index applicable at the time the contract was awarded, to bring the data back to a December 1969 base.

An example of these operations follows:

Element: EXCAVATION (Category 1)

Month: November 1972 $I_p = 129$

Location: San Francisco $I_g = 113$

$$K = \frac{1.0}{1.25 \times 1.29 \times 1.13} = 0.54881$$

Element Cost = $1238

Base Cost = 1238 x .054881 = $679

Units = 100 CY

The base cost data for this element is $679 for 100 CY of excavation.

These procedures were applied to all available data, with the result that a family of costs and units were developed for each major item within each of the twelve categories. The information derived from the projects and the resulting base data are tabulated in Appendix A for each category and item.

As indicated by Doyle[4], the method of least squares proved to be a valuable tool in fitting known data to a trend curve. A computer program was written to select the first, second, or third order polynominal equation that had the best least squares fit to the base

cost data provided for each item. The program utilized is shown in Exhibits 7-1A and 7-1B.

The second phase of the computer program applied the uniform unit increases to the selected equation so that a graphical plot could be developed. The first, second or third order equation that best fit the data presented was selected as the base data graph. Generally a second order equation was found to provide the most realistic graphical plot of the data presented.

The computer printouts of the evaluated data, the resulting equations, and the projected data points for each item in each category are included in Appendix A for each item of the twelve categories.

The graphical plots of the base data which will be applied by the user of this system are included in Appendix B. Table 6-6 and Figure 5-2 are also reproduced in Appendix B in order that the user by following the simple instructions contained therein, will need only Appendix B to determine cost estimates for proposed projects.

Using this system reasonably accurate cost estimates can be determined for projects up to $200,000 in less than three hours, providing sufficient parameter data are available.

```
      DIMENSION X(50),Y(50),W(50),A(5,5),SUMX(7),SUMY(4)
C     GALLEN,J.J., THESIS 1973
C     POLYNOMIAL CURVE FIT
      PRINT 210
    1 READ 200,XNAME1,XNAME2,N,LAST,NPRO
C     N IS THE NUMBER OF OBSERVATIONS
C     XNAME IS THE CODE NAME. NPRO ARE POINTS PROJECTED.
C     LAST IS THE HIGHEST ORDER POLYNOMIAL FITTED
      IF(N)220,220,2
    2 READ 202,(X(I),Y(I),W(I),I=1,N)
C     X IS THE INDEPENDENT VARIABLE IN UNITS.
C     Y IS THE DEPENDENT VARIABLE IN DOLLARS
C     W IS AN OPTIONAL WEIGHT FACTOR (USUALLY W=1.0)
C     PUNCH DATA ON SINGLE CARDS
      DO 22 I=1,N
      IF (W(I))22,21,22
   21 W(I)=1.0
   22 CONTINUE
      SUMX(1)=0.0
      SUMX(2)=0.0
      SUMX(3)=0.0
      SUMY(1)=0.0
      SUMY(2)=0.0
      DO 90 I=1,N
      SUMX(1)=SUMX(1)+W(I)
      SUMX(2)=SUMX(2)+W(I)*X(I)
      SUMX(3)=SUMX(3)+W(I)*X(I)**2
      SUMY(1)=SUMY(1)+W(I)*Y(I)
   90 SUMY(2)=SUMY(2)+W(I)*X(I)*Y(I)
      NORD=1
   93 L=NORD+1
      KK=L+1
      DO 101 I=1,L
      DO 100 J=1,L
      IK=J-1+I
  100 A(I,J)=SUMX(IK)
  101 A(I,KK)=SUMY(I)
      DO 140 I=1,L
      A(KK,I)=-1.0
      KKK=I+1
      DO 110 J=KKK,KK
  110 A(KK,J)=0.0
      C=1.0/A(1,I)
      DO 120 II=2,KK
      DO 120 J=KKK,KK
  120 A(II,J)=A(II,J)-A(1,J)*A(II,I)*C
      DO 140 II=1,L
      DO 140 J=KKK,KK
  140 A(II,J)=A(II+1,J)
```

EXHIBIT 7-1A

```
      PRINT 203,XNAME1,XNAME2,NORD,N
      DO 164 I=1,L
      J=I-1
  164 PRINT 207,J,A(I,KK)
      PRINT 209
      DO 169 I=1,N
      S1=A(1,KK)
      DO 168 J=1,NORD
  168 S1=S1+A(J+1,KK)*X(I)**J
      S3=Y(I)-S1
      DIV=Y(I)/S1
  169 PRINT 3,X(I),Y(I),W(I),S1,S3,DIV
      IF(NPRO)170,170,299
  299 DIF=2.0
      DO 310 M=1,NPRO
      F=M
      FUT=0.0
      VAL=0.0+DIF*F                       EXHIBIT 7-1B
      DO 300 I=1,L
      J=I-1
  300 FUT=FUT+A(I,KK)*VAL**J
  310 PRINT 4,VAL,FUT
  170 PRINT 210
      IF(NORD-LAST)171,1,1
  171 NORD=NORD+1
      J=2*NORD
      SUMX(J)=0.0
      SUMX(J+1)=0.0
      SUMY(NORD+1)=0.0
      DO 172 I=1,N
      SUMX(J)=SUMX(J)+W(I)*X(I)**(J-1)
      SUMX(J+1)=SUMX(J+1)+W(I)*X(I)**J
  172 SUMY(NORD+1)=SUMY(NORD+1)+W(I)*Y(I)*X(I)**NORD
      GO TO 93
  220 PRINT 211
      STOP
  200 FORMAT(A10,A2,1X,I2,1X,I1,1X,I3)
  202 FORMAT(F5.0,3X,F6.1,2XF4.1)
  203 FORMAT(38H CODE NAME       POLYNOMIAL CURVE FIT
     1 4X,A10,A2//1X,20HORDER   OBSERVATIONS
     1 1X,I3,8X,I5//)
  207 FORMAT(1X,I3,3X,E13.6)
  209 FORMAT(1X,88HINDEPEND VAR  DEPEND VAR  WEIGHT
     1FITTED DEPEND  ARITH DIFFERENCE
     1RATIO OBSERVED TO FIT)
  210 FORMAT(1H1)
  211 FORMAT(1X//11H END OF JOB / 1H1)
    3 FORMAT(1X,F11.3,2X,F11.3,1X,F7.3,3X,F11.3,
     14X,F11.3,10X,F11.3)
    4 FORMAT(1X,F11.3,24X,F11.3)
C     NOTE.   SIX BLANKS WERE INSERTED AFTER
C     CARD 140 AND CARDS 203,209, AND 3 WERE
C     ADJUSTED TO CONFORM TO THESIS PAPER SIZE.
      END
```

CHAPTER VIII

ANALYSIS AND COMMENT

As the intent of this thesis was the development of a generalized system for preliminary cost estimates, the analysis of the project data involved considerable screening. Unique items were purposely omitted, as cost curves could not be meaningfully developed from only two or three data points. This siutation was particularly obvious in attempting to develop curves for Category 11 (Specialities).

In applying this system, the estimator must use his own judgement for those cost items not covered by any of the curves developed. In other cases he may want to apply a factor to adapt the given curves to a similar application. An example of such a modification would be the multiplication of the quantity excavated by a factor of 2.0 when the user knows that most of the work involves rock excavation rather than the more normal gravel or clay work for which the curve was developed.

The 55 cost curves developed represent expected costs for the items and categories considered. Some were based on many data observations, others on

relatively few. All represent complete, in-place costs including cleanup. For the items that would necessarily involve supporting work such as forming, reinforcing, form stripping and finishing in the case of concrete work all these factors were included in the development of the cost curves. The project prices reviewed were also considered to have been those of the lowest responsible bidder in a competitive environment, as no information to the contrary was available.

Specific comments for some of the categories are as follows:

Category 1 (Foundations)

A good portion of the work involved in this category requires heavy equipment work. The usage costs associated with the equipment involved were related directly to labor costs and were so considered.

Category 4 (Walls)

Since most construction in the range considered involved bearing walls rather than structural framing, more data was available in curve development in this area than in Category 2 (Structural).

Category 5 (Roofing)

The cost curves developed for roofing include the normal flashing associated with this work but do not take into consideration sheet

metal gutters which should be considered under ductwork (Category 9) at approximately 3/4 lb. per ft. Removal work includes removal from the station.

Category 6 (Finishes).

Exterior paint was considered a two coat operation whereas interior was a single coat application.

Category 7 (Doors and Windows)

Prefabrication of these items allowed a relatively low installation labor/material ratio.

Category 8 (Plumbing)

Within the ranges indicated, installation varied little from one pipe size to the next, which facilitated the grouping of close sizes into single cost curves.

Plumbing fixtures, regardless of whether they are commodes, urinals, lavatories or hot water heaters, all have a certain amount of very similar rough-in piping associated with their installation. Since the material costs do not vary significantly fron one type of fixture to another, their consideration as one category (fixtures) was adopted.

Category 9 (H.V.A.C.)

Since the major equipment in this category was found in most instances to be single

applications, the graphs presented are based on the size or capacity of those systems. This approach should be more useful to the user. Size was not considered for either ductwork or registers as most fall within a standard range of usage.

Category 10 (Electrical)

As was pipe work, the formulation of cost graphs for both wire and conduit were by specific ranges. Panels and transformers were based on capacity and size.

Light fixtures were generally found to fall within a range of normal application.

Category 11 (Specialities)

The only speciality item for which there was sufficient data to develop a cost curve was the sprinkler system. The curve presented plots the number of sprinkler heads against cost. Alarms are included in these costs. Either wet or dry systems apply.

Category 12 (Exterior)

Generally the last phase of work completed on a project, items in this category all include final cleanup. Project costs in this category were considered to be understated when the scope of the project was not centered on exterior work.

CHAPTER IX

CONCLUSIONS

This estimating system is based upon an analysis of actual costs on completed projects from various parts of the country. The curves represent the general cost trends for each of the 55 construction category items.

The application of the system to four of the submitted projects in the $10,000 to $25,000 range indicated that the cost curves and the system are in fact valid. Appendix C contains this application and analysis. It is expected that, with this system, project cost estimates can be readily determined that will have an accuracy of within ± 15%, particularly for projects whose value is between $25,000 and $200,000.

This method enables the estimator to develop preliminary cost estimates for minor public works projects in less than three hours. Although the system does encompass many construction items, and does enable him to perform his estimating tasks in a more expedient manner, it is still merely an estimating tool. The system is not intended as a substitute for the good judgement of the estimator.

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APPENDIX A

CALCULATIONS OF BASE DATA

The detailed analysis of all of the elements used to construct each of the category item graphs is contained in the attached tables. Following these Tables are the computer printouts of the base data, the best ordered, polynomial equation fit, and the projected data points. Appendix B contains the graphs that resulted from these equations.

Category 1: Foundations

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Excavation							CY
08-71	116.6	Corpus	Dallas	77	.89105	$1566	$1394	261
11-71	119.0	Corpus	Dallas	77	.87308	2354	2055	325
07-67	76.2	Wash, DC	Baltimore	96	1.09631	840	919	120
07-72	126.2	L.A.	L.A.	110	.57629	3010	1734	350
03-72	123.0	Crane, Ind.	Cincinnati	104	.62539	2115	1323	282
05-72	124.6	Crane, Ind.	Cincinnati	104	.61736	265	164	9
11-72	129.0	San Fran.	San Fran.	113	.54881	1238	679	100
02-73	131.1	Phil., Pa	Phil, Pa.	101	.60418	400	242	20
06-68	85.4	Wash, DC	Baltimore	96	.97580	495	483	30
08-72	127.0	San Fran.	San Fran.	113	.55745	3220	1794	460
06-68	85.4	Wash, DC	Baltimore	96	.97580	2800	2733	750
07-72	126.2	L.A.	L.A.	110	.57629	3300	1903	550
05-72	124.6	L.A.	L.A.	110	.58369	1686	984	200
12-71	120.5	Memphis	Atlanta	80	.82988	1782	1479	170
03-72	123.0	Memphis	Atlanta	80	.81301	510	415	51
11-72	129.0	Charles, SC	Atlanta	80	.77519	925	716	161
11-71	119.7	Columbus	Cleveland	107	.62461	4200	2625	500
Item:	Concrete							CY
03-72	123.0	L.A.	L.A.	110	.57629	390	225	3
07-72	126.2	Columbus	Cleveland	107	.59244	661	392	4
12-71	120.5	Corpus	Dallas	77	.86221	2350	2024	20
06-72	125.4	Jax, Fla.	Atlanta	70	.79745	3600	2901	30
07-72	126.2	L.A.	L.A.	110	.57629	7020	4044	35
02-73	131.1	Phil, Pa.	Phil, Pa.	101	.60418	3930	2375	40
08-72	127.0	Memphis	Atlanta	80	.78740	5240	4125	50
07-67	76.2	Wash, DC	Baltimore	96	1.09361	4395	4806	60
03-72	123.0	Crane, Ind.	Cincinnati	104	.62539	10890	6810	90
03-72	123.0	Memphis	Atlanta	80	.81301	24322	19775	293

Category 1: Foundations (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
12-71	120.5	Memphis	Atlanta	80	.82988	15550	12905	157
07-72	126.2	L.A.	L.A.	110	.57629	55670	32082	600
06-68	85.4	Wash, DC	Baltimore	96	.97580	16500	16094	210
09-72	127.9	Corpus	Dallas	77	.81232	16880	13714	140
07-71	115.7	Corpus	Dallas	77	.89798	32985	29620	450
08-71	116.6	Corpus	Dallas	77	.89105	37780	33661	528
Item:	Compacted Fill							CY
08-72	127.0	Memphis	Atlanta	80	.78740	$748	$588	67
03-72	123.0	Columbus	Cleveland	107	.60786	3205	1949	330
11-72	129.0	San Fran.	San Fran.	113	.54881	1870	1025	150
07-72	126.2	Boston	Boston	104	.60953	5195	3166	675
08-72	127.0	Crane, Ind.	Cincinnati	104	.60569	1870	1133	110
08-72	127.0	San Fran.	San Fran.	113	.55745	4140	2309	460
11-72	129.0	Charles, SC	Atlanta	80	.77519	1156	897	127
03-72	123.0	Crane, Ind.	Cincinnati	104	.62539	4520	2825	500
06-72	125.4	Seattle	Seattle	95	.57996	1360	788	135
12-71	120.5	Memphis	Atlanta	80	.82988	774	642	120

Removals: Asphalt 0.65/SF
Block 1.60/SF
Concrete 5.35/SF

Category 2: Structural

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item: Steel								Tons
07-72	126.2	Boston	Boston	106	.59756	$2000	$1195	.5
11-72	129.0	L.A.	L.A.	100	.62016	5230	3242	2.75
12-72	129.5	Phil.	Phil.	105	.58834	9890	5820	4.5
03-72	123.0	Columbus	Cleveland	106	.61359	13642	8371	11.0
11-71	119.7	Corpus	Dallas	89	.75094	12474	9366	14.0
11-72	129.0	Memphis	Atlanta	89	.69680	15180	10577	17.5
07-68	86.1	Wash.,DC	Baltimore	101	.91995	11000	10120	20.0
12-72	129.5	Crane, Ind.	Cincinnati	103	.59977	17220	10332	22.5
07-68	86.1	Wash.,DC	Baltimore	101	.91995	12590	11575	25.0
03-72	123.0	L.A.	L.A.	100	.65041	19965	12989	31.0
01-72	121.3	Charles,SC	Atlanta	89	.74104	16970	12575	35.0
Item: Concrete								CY
07-68	86.1	Wash.DC	Baltimore	101	.91995	6020	5536	40
11-72	129.0	L.A.	L.A.	100	.62016	9522	5905	56
12-71	120.5	Memphis	Atlanta	89	.74595	9190	6855	65
03-72	123.0	Crane, Ind.	Cincinnati	103	.63146	11840	7476	90
07-72	126.2	L.A.	L.A.	100	.63391	13664	8662	180
Item: Wood Framing								BF
06-72	125.4	Jax, Fla.	Atlanta	89	.71681	422	332	544
11-72	129.0	L.A.	L.A.	100	.62016	478	296	605
05-71	114.1	Omaha	Kansas City	100	.70114	590	414	900
07-71	115.7	Corpus	Dallas	89	.77690	660	516	1200
08-71	116.5	Corpus	Dallas	89	.77157	750	580	1000
05-72	124.6	Crane, Ind.	Cincinnati	103	.62335	1555	970	2064
12-72	110.0	McAlester, Okla.	Dallas	89	.81716	1132	925	2500

Category 3: Flooring

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Resilient Tile							SF
08-71	116.5	Corpus	Dallas	83	.82734	$1440	$1191	4800
11-71	119.7	Corpus	Dallas	83	.80523	880	709	1600
08-71	116.5	Corpus	Dallas	83	.82734	1045	865	1900
05-72	124.6	Crane,Ind.	Cincinnati	90	.65516	301	197	258
09-72	127.9	Crane,Ind.	Cincinnati	98	.63825	450	287	450
06-68	85.3	Omaha	Kansas City	109	.86043	537	462	950
06-68	85.3	Omaha	Kansas City	109	.86043	760	654	950
06-72	125.4	Jax, Fla.	Atlanta	87	.73329	2910	2134	7000
03-72	123.0	Dallas	Dallas	83	.78362	296	232	352
08-72	127.0	New Orleans	New Orleans	77	.81508	352	288	550
03-72	123.0	L.A.	L.A.	99	.65698	383	252	478
05-72	124.6	Seattle	Seattle	101	.63570	232	148	160
07-72	126.2	Seattle	Seattle	101	.62764	1830	1149	2866
03-72	123.0	Memphis	Atlanta	87	.74754	1555	1163	4320
06-72	125.4	Annapolis	Baltimore	105	.60758	1786	1085	1821
Item:	Carpet							SF
03-72	123.0	Dallas	Dallas	83	.78362	2655	2081	2700
08-72	127.0	New Orleans	New Orleans	77	.81508	2020	1647	1810
09-72	127.9	Crane,Ind.	Cincinnati	98	.63825	2000	1227	936
06-72	125.4	Annapolis	Baltimore	105	.60758	2430	1476	1354
06-72	125.4	Annapolis	Baltimore	105	.60758	3050	1853	1737
Item:	Plywood/Underlayment							SF
09-72	127.9	Great Lakes	Chicago	101	.61930	4932	3054	14508
10-72	128.7	Newport, RI	Boston	113	.55009	995	547	710
05-72	124.6	Crane,Ind.	Cinconnati	98	.65516	3225	2113	694
06-68	85.3	Omaha	Kansas City	109	.86043	1115	959	1810

Category 3: Flooring (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
07-72	126.2	Seattle	Seattle	101	.62764	2690	1689	4120
06-72	125.4	Annapolis	Baltimore	105	.60758	3505	2130	10114
Item:	Ceramic Tile							SF
09-72	127.9	Great Lakes	Chicago	101	.61930	$2738	$1696	996
07-71	115.7	Dallas	Dallas	83	.83306	7000	5831	4000
10-72	128.7	Newport,RI	Boston	113	.55009	1144	629	260
08-72	127.0	New Orleans	New Orleans	77	.81508	500	409	100
12-72	129.5	Gulfport,MS	New Orleans	77	.80229	2600	2086	520
08-71	116.5	Corpus	Dallas	83	.82734	5552	4593	2600
12-72	129.5	San Fran.	San Fran.	103	.59977	1204	722	325
05-72	124.6	Seattle	Seattle	101	.63570	2286	1453	900
10-71	118.2	Charles,SC	Atlanta	87	.77795	4216	3280	1441
09-72	127.9	Great Lakes	Chicago	101	.61920	2490	1542	830
Item:	Accoustical Tile							SF
09-72	127.9	Great Lakes	Chicago	101	.61930	1036	642	1328
03-72	123.0	Dallas	Dallas	83	.78362	1560	1222	2600
08-72	127.0	New Orleans	New Orleans	77	.81508	100	82	100
04-71	113.3	Corpus	Dallas	83	.85071	1620	1368	3600
08-71	116.5	Corpus	Dallas	83	.82734	2160	1787	4800
11-71	119.7	Corpus	Dallas	83	.80523	2200	1777	5000
09-72	127.9	Crane,Ind.	Cincinnati	98	.63825	1800	1149	3000
06-68	85.3	Omaha	Kansas City	109	.86043	650	559	650
10-72	128.7	Jax, Fla.	Atlanta	87	.71448	1387	991	2040
04-72	123.8	Jax, Fla.	Atlanta	87	.74276	484	359	515
12-72	129.5	San Fran.	San Fran.	103	.59977	1416	849	1900
09-72	127.9	San Fran.	San Fran.	102	.60727	1050	638	1400
05-72	124.6	Seattle	Seattle	101	.63510	1596	1015	2100
07-72	126.2	Seattle	Seattle	101	.62764	2379	1493	2973

Category 3: Flooring (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
03-72	123.0	Memphis	Atlanta	87	.74759	2168	1621	4251
07-72	126.2	Boston	Boston	113	.56099	2000	1122	2000
05-71	113.3	Corpus	Dallas	83	.85071	1176	1000	1400
06-72	125.4	Annapolis	Baltimore	105	.60758	1857	1128	1976
Item: Concrete Slabs and Lightweight Concrete Roofs								
08-72	127.0	New Orleans	New Orleans	77	.81808	1059	866	1059
05-71	113.3	Corpus	Dallas	83	.85071	7680	6533	9600
09-72	127.9	Crane, Ind.	Cincinnati	98	.63825	4100	2617	3000
04-71	113.3	Omaha	Kansas City	109	.86043	85	73	160
05-72	124.6	Seattle	Seattle	101	.63570	1980	1259	2200
06-72	125.4	Columbus	Cleveland	106	.60185	410	247	200
12-72	129.5	San Fran.	San Fran.	102	.59977	6088	3553	7220
06-72	125.4	Annapolis	Baltimore	105	.60758	5487	3334	5000
03-72	123.0	L.A.	L.A.	99	.65698	8844	5810	8300

Category 4: Walls

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Brick Walls							SF
09-72	127.9	Corpus	Dallas	79	.79176	$2896	$2293	1067
06-71	114.9	Corpus	Dallas	79	.88134	11760	10365	5600
08-71	116.6	Corpus	Dallas	79	.86849	9145	7942	4133
08-72	127.1	Crane,Ind.	Cincinnati	106	.59380	9640	5724	2700
06-68	85.3	Wash,DC	Baltimore	100	.93786	6692	6272	2800
03-72	123.0	L.A.	L.A.	104	.62539	18336	11467	6035
10-71	118.2	Charles,SC	Atlanta	85	.79626	14830	11809	5467
01-73	130.3	Charles,DC	Atlanta	85	.72231	4500	3250	1450
Item:	CMU (Concrete Masonry Units)							SF
06-71	114.9	Corpus	Dallas	79	.88134	11447	10089	8850
11-71	119.0	Corpus	Dallas	79	.85097	4725	4021	3097
08-71	116.6	Corpus	Dallas	79	.86849	7020	6097	5310
05-72	124.6	Crane,Ind.	Cincinnati	106	.60571	452	274	131
02-72	122.1	Crane,Ind.	Cincinnati	105	.61811	3637	2248	1858
06-68	85.3	Wash, DC	Baltimore	100	.93786	4400	4142	3540
04-71	113.3	Omaha	Kansas City	100	.70609	1517	1071	607
06-68	85.3	Omaha	Kansas City	100	.93786	413	387	300
06-72	125.4	Annapolis	Baltimore	100	.63796	675	431	265
07-72	126.2	Annapolis	Baltimore	100	.63391	850	532	442
07-72	126.2	Boston	Boston	105	.60373	3180	1920	1000
07-72	126.3	Boston	Boston	105	.60373	1223	651	532
Item:	Drywall (Gypsum Board)							SF
08-71	116.6	Corpus	Dallas	79	.86849	1235	1073	1900
02-72	122.1	Crane,Ind.	Cincinnati	106	.61811	3240	2003	5400
06-68	85.3	Omaha	Kansas City	100	.93786	846	793	820
04-71	113.3	Omaha	Kansas City	100	.70609	412	291	220

Category 4: Walls (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
06-68	85.3	Omaha	Kansas City	100	.93786	$913	$856	1230
12-72	129.5	San Fran.	San Fran.	109	.56675	1309	742	1400
10-72	128.7	Jax, Fla.	Atlanta	85	.73129	2016	1474	4164
03-72	123.0	L.A.	L.A.	104	.62539	2417	1512	5300
07-72	126.2	L.A.	L.A.	104	.60953	1695	1033	3300
07-72	126.2	Seattle	Seattle	100	.63391	2961	1877	6300
06-72	125.4	Annapolis	Baltimore	100	.63796	1857	1185	1857
06-72	125.4	Annapolis	Baltimore	100	.63796	3037	1937	3880
07-72	126.2	Boston	Boston	105	.60373	1980	1195	1800
07-72	126.2	Boston	Boston	105	.60373	5000	3019	7000
Item:	Insulation							SF
05-71	114.1	Corpus	Dallas	79	.88752	320	284	4000
12-72	129.5	San Fran.	San Fran.	109	.56675	726	411	5660
03-72	123.0	L.A.	L.A.	104	.62539	691	432	4950
07-72	126.2	L.A.	L.A.	104	.60953	436	266	2000
03-72	123.0	Memphis	Atlanta	85	.76518	434	332	3272
07-72	126.2	Seattle	Seattle	100	.63391	360	228	2400
07-72	126.2	Seattle	Seattle	100	.63391	413	262	1750
07-72	126.2	Boston	Boston	105	.60373	200	121	1000

Category 5: Roofing

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Removals							SQ
08-72	127.0	New Orleans	New Orleans	83	.75894	$2400	$1821	80
04-71	113.3	Omaha	Kansas City	103	.68552	2050	1405	82
04-72	123.8	McAllester	Dallas	89	.72607	4272	3100	200
08-72	127.0	Dallas	Dallas	89	.70778	8178	5777	348
09-72	127.9	McAllester	Dallas	89	.70280	6750	4744	375
07-71	115.7	Dallas	Dallas	89	.77690	10320	8018	516
01-71	110.8	Corpus	Dallas	89	.81126	8047	6528	522
Item:	Shingles							SQ
12-72	129.5	Gulfport,MS	New Orleans	83	.74429	5000	3720	80
05-72	123.8	McAllester	Dallas	89	.72607	8430	6120	200
04-72	123.8	McAllester	Dallas	89	.72607	9657	7012	280
08-72	127.0	Dallas	Dallas	89	.70778	9778	6920	348
09-72	127.9	McAllester	Dallas	89	.70280	12078	8488	375
Item:	Built-up Roofing							SQ
06-68	85.3	Wash, DC	Baltimore	92	1.01942	1329	1355	15
10-72	128.7	Crane,Ind.	Cincinnati	113	.55009	5100	2805	34
05-72	124.6	Seattle	Seattle	100	.64205	2720	1746	40
03-72	123.0	L.A.	L.A.	107	.60786	4860	2954	49
09-71	117.4	Corpus	Dallas	89	.76565	8044	6159	90
04-71	113.3	Omaha	Kansas City	103	.68552	5011	3435	82
09-72	127.0	New Orleans	New Orleans	83	.75894	5480	4160	80
04-71	113.3	Omaha	Kansas City	103	.68552	7927	5434	110
06-68	85.3	Wash,DC	Baltimore	92	1.01942	6400	6524	128
11-72	128.7	New York	New York	117	.53128	12230	6500	130
03-72	123.0	Crane,Ind.	Cincinnati	113	.57558	9828	5657	126
11-71	119.7	Corpus	Dallas	89	.75094	9780	7340	200

Category 5: Roofing (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
07-72	126.2	Memphis	Atlanta	88	.72036	8395	6048	189
01-73	130.3	New Orleans	New Orleans	83	.73972	5000	3700	50
08-71	116.6	Corpus	Dallas	89	.77091	5535	4267	125
06-72	125.4	Seattle	Seattle	100	.63796	8960	5716	120
06-72	125.4	Seattle	Seattle	100	.63796	500	319	3
06-72	125.4	Seattle	Seattle	100	.63796	5704	3639	74
06-72	125.4	SEattle	Seattle	100	.63796	6381	4071	82

Category 6: Finishes

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Vinyl Wall Covering							SF
07-72	126.2	Boston	Boston	102	.62148	$2110	$1311	1000
05-72	124.6	Seattle	Seattle	95	.67585	304	205	160
09-72	127.9	San Fran.	San Fran.	111	.56350	312	176	720
06-72	125.4	Jax, Fla.	Atlanta	88	.72495	381	276	900
05-71	113.3	Corpus	Dallas	85	.83069	2762	2294	4000
05-71	114.1	Corpus	Dallas	85	.82487	2000	1650	2000
08-71	116.5	Corpus	Dallas	85	.80788	2624	2120	3200
08-72	127.0	Dallas	Dallas	85	.76518	1932	1478	1800
Item:	Exterior Painting							SF
05-72	124.6	Boston	Boston	102	.62947	1000	629	2000
03-72	123.0	Columbus	Cleveland	114	.57053	5700	3252	7500
11-72	129.0	Charles,SC	Atlanta	88	.70472	5200	3665	10000
01-73	130.3	Charles,SC	Atlanta	88	.69769	825	576	1500
10-71	118.2	Charles,SC	Atlanta	88	.76911	4756	3658	16900
05-72	124.6	Seattle	Seattle	95	.67585	2640	1784	6000
03-72	123.0	L.A.	L.A.	105	.61943	2611	1617	5800
06-72	125.4	L.A.	L.A.	105	.60758	2277	1383	2300
11-72	129.0	San Fran.	San Fran.	111	.55870	6930	3872	21000
05-71	114.1	Corpus	Dallas	85	.82487	9575	7898	35600
09-72	127.9	Corpus	Dallas	85	.73570	2000	1477	4000
07-71	115.7	Corpus	Dallas	85	.81346	7075	5755	28000
11-71	119.7	Corpus	Dallas	85	.78628	3120	2453	6000
09-71	116.5	Corpus	Dallas	85	.80788	3000	2424	6000
07-72	126.2	New Orleans	New Orleans	82	.77307	7707	5958	24500
08-72	127.0	New Orleans	New Orleans	82	.76820	16000	1229	2000

Category 6: Finishes (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Interior Painting							SF
07-72	126.2	Boston	Boston	102	.62148	$250	$155	500
12-72	129.5	Annapolis	Baltimore	97	.63687	500	318	2000
11-72	129.0	Charles,SC	Atlanta	88	.70742	3825	3096	20000
12-71	120.5	Memphis	Atlanta	88	.75443	773	583	3579
03-72	123.0	Memphis	Atlanta	88	.73910	4937	3649	33847
07-72	126.2	L.A.	L.A.	105	.60373	1200	724	4000
05-71	113.3	L.A.	L.A.	105	.67247	2790	1876	15500
09-72	127.9	San Fran.	San Fran.	111	.56350	918	517	2480
10-72	128.7	Chicago	Chicago	109	.57028	2075	1184	12000
10-72	128.7	Jax, Fla.	Atlanta	88	.70636	551	389	2900
06-72	125.4	Jax, Fla.	Atlanta	88	.72495	2172	1575	12000
12-72	129.5	Phil, Pa.	Phil, Pa.	106	.58279	1000	583	2500
02-72	127.2	Crane,Ind.	Cincinnati	107	.61184	375	229	1500
04-71	113.3	Corpus	Dallas	85	.83069	1200	997	10000
05-71	113.3	Corpus	Dallas	85	.83069	7410	6155	39000
04-72	123.8	Gulfport,MS	New Orleans	82	.78805	3000	2364	15000
10-72	128.7	Pensacola	Atlanta	88	.70636	6690	4725	23000
08-72	127.0	Dallas	Dallas	85	.74108	650	482	3500

Category 7: Doors and Windows

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Doors and Frames							EA
08-72	127.0	Cincinnati	Cincinnati	94	.67013	$4140	$2774	16
06-72	125.4	New Orleans	New Orleans	101	.63164	400	253	1
06-72	125.4	New Orleans	New Orleans	101	.63164	3000	1895	12
12-72	129.5	Great Lakes	Chicago	95	.65027	960	624	4
09-72	127.9	Great Lakes	Chicago	95	.65841	5779	3805	23
09-72	127.9	Great Lakes	Chicago	95	.65841	7823	5151	45
07-72	126.2	Newport,RI	Boston	104	.60953	1400	853	8
09-71	116.5	Corpus	Dallas	92	.74641	4427	3304	21
03-72	123.0	L.A.	L.A.	108	.60223	3810	2294	20
01-73	130.3	Charles,SC	Atlanta	105	.58473	435	255	1
07-72	126.2	L.A.	L.A.	108	.58696	1215	713	4
04-71	113.3	L.A.	L.A.	108	.65379	5953	3982	32
11-71	119.7	Corpus	Dallas	92	.72645	2248	1633	10
10-72	128.7	Great Lakes	Chicago	95	.65432	4515	2954	18
07-72	126.2	Boston	Boston	104	.60953	2500	1524	12
10-72	128.7	Gulfport	New Orleans	101	.61545	5580	3436	25
Item:	Aluminum Windows							EA
09-72	127.0	New Orleans	New Orleans	101	.62368	3500	2183	18
11-72	129.0	San Fran.	San Fran.	116	.53462	1428	763	6
09-72	127.9	Annapolis	Baltimore	105	.60953	4000	2438	17
07-72	126.2	Boston	Boston	104	.60953	4000	2438	17
06-72	125.4	Boston	Boston	104	.61342	1500	920	7
08-72	127.0	Pensacola	Atlanta	105	.59992	8608	5200	33
09-72	127.9	Corpus	Dallas	92	.67988	2256	1534	11
Item:	Toilet Partitions							
06-72	125.4	Seattle	Seattle	116	.54996	1964	1080	12

Category 7: Doors and Windows (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
02-72	122.2	Crane, Ind.	Cincinnati	94	.74328	$945	$702	7
11-72	129.0	San Fran.	San Fran.	116	.53462	463	248	3
11-71	119.7	Corpus	Dallas	92	.72645	408	296	3
08-71	116.5	Corpus	Dallas	92	.74641	816	609	6
10-72	128.7	Great Lakes	Chicago	95	.65432	250	164	2
09-72	127.9	Great Lakes	Chicago	95	.65841	512	837	8
Item:	Window Glass							SF
06-72	125.4	New Orleans	New Orleans	101	.63164	1000	632	200
06-68	85.4	Wash, DC	Baltimore	104	.90074	2450	2207	980
03-72	123.0	L.A.	L.A.	108	.60223	4131	2488	1200
05-72	124.6	Seattle	Seattle	116	.55350	1548	857	400
03-72	123.0	Memphis	Atlanta	105	.61943	359	272	124
11-72	129.0	Jax, Fla.	Atlanta	105	.59062	650	384	100
11-71	119.7	Corpus	Dallas	92	.72645	225	163	75
07-72	126.2	Boston	Boston	104	.60953	2980	1816	700

Category 8: Plumbing

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Fixtures							EA
02-72	122.2	Crane, Ind.	Cincinnati	100	.65466	$2737	$1792	15
10-72	128.7	Jax, Fla.	Atlanta	90	.69067	5425	3747	22
03-72	123.0	L.A.	L.A.	115	.56557	7180	4060	28
10-71	118.2	Memphis	Atlanta	90	.75202	5735	4313	32
06-71	114.9	Corpus	Dallas	85	.81913	4250	3481	19
Item:	Manholes							EA
12-72	129.5	Crane, Ind.	Cincinnati	100	.61176	2100	1297	4
06-72	125.4	L.A.	L.A.	115	.55475	4640	2574	6
05-71	113.3	L.A.	L.A.	115	.61399	6127	3767	19
10-71	118.2	Memphis	Atlanta	90	.75202	4470	3373	13
11-72	129.0	New Yrok	New York	92	.67408	1100	741	2
11-72	129.0	Pensacola	Atlanta	90	.68906	3600	2481	8
10-72	127.0	Great Lakes	Chicago	99	.63628	2685	1709	3
Item:	Pipe, Cast Iron, 2" to 8"							LF
12-72	129.5	Crane, Ind.	Cincinnati	100	.61176	2464	1522	176
12-72	129.5	Crane, Ind.	Cincinnati	100	.61176	2352	1453	196
12-72	129.5	Crane, Ind.	Cincinnati	100	.61176	3600	2224	240
11-72	129.0	San Fran.	San Fran.	97	.63394	435	278	80
03-72	123.0	Memphis	Atlanta	90	.72267	1350	976	90
03-72	123.0	Memphis	Atlanta	90	.72267	620	448	100
10-71	118.2	Memphis	Atlanta	90	.75202	3901	2934	900
11-72	129.0	New York	New York	92	.67408	3524	2375	400
10-72	128.7	Great Lakes	Chicago	99	.62788	800	502	50
10-72	128.7	Great Lakes	Chicago	99	.62788	1380	866	100
08-72	127.0	Great Lakes	Chicago	99	.63628	1040	662	52
08-72	127.0	Great Lakes	Chicago	99	.63628	3000	1909	250

Category 8: Plumbing (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Pipe, Mechanical Joint, 2" to 8"							LF
10-71	118.2	Memphis	Atlanta	90	.75202	$371	$279	90
10-71	118.2	Memphis	Atlanta	90	.75202	7018	5278	972
10-71	118.2	Memphis	Atlanta	90	.75202	1262	949	252
06-71	114.9	Corpus	Dallas	85	.81913	3696	3027	560
11-71	119.7	Corpus	Dallas	85	.78628	1700	1338	200
02-72	122.2	Phil, Pa.	Phil,Pa.	114	.57427	7200	4135	670
02-72	122.2	Phil,Pa.	Phil,Pa.	114	.57427	8750	5025	750
02-72	122.2	Phil,Pa.	Phil,Pa.	114	.57427	4000	2297	400
02-72	122.2	Phil,Pa.	Phil,Pa.	114	.57427	4500	2584	500
Item:	Pipe, Copper, ½" to 2"							LF
09-72	127.9	San Fran.	San Fran.	97	.64483	564	364	125
03-72	123.0	Memphis	Atlanta	90	.72267	744	538	240
03-72	123.0	Memphis	Atlanta	90	.72267	120	87	80
03-72	123.0	Dallas	Dallas	85	.76518	1500	1148	400
03-72	123.0	Dallas	Dallas	85	.76518	850	650	270
10-72	128.7	Great Lakes	Chicago	99	.62788	2500	1570	500
Item:	Pipe, 4" to 8", P.V.C. (Polyvinyl Chloride)							LF
05-72	124.6	San Fran.	San Fran.	97	.66191	4356	2883	860
09-72	127.9	San Fran.	San Fran.	97	.64483	1181	762	20
08-72	127.9	San Fran.	San Fran.	97	.64483	1540	993	40
12-72	129.5	L.A.	L.A.	115	.53718	13400	7198	2000
12-72	129.5	L.A.	L.A.	115	.53718	9255	4971	1400
12-72	129.5	L.A.	L.A.	115	.53718	2380	1278	300
09-72	127.0	Great Lakes	Chicago	99	.63628	1595	1016	85
Item:	Pipe, Steel (Black Iron or Galvinized), 1" or less							LF
12-72	129.5	Crane,Ind,	Cincinnati	100	.61176	1999	1235	714

Category 8: Plumbing (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
05-72	124.6	Crane,Ind.	Cincinnati	100	.61776	$6177	$3816	1825
11-72	129.0	Crane,Ind.	Cincinnati	100	.62016	726	450	220
11-72	129.0	Crane,Ind.	Cincinnati	100	.62016	598	371	160
09-72	127.9	San Fran.	San Fran.	97	.64483	330	213	100
08-71	116.5	Corpus	Dallas	85	.80788	441	356	105
06-68	85.4	Wash,DC	Baltimore	97	.97029	1000	970	500
08-72	127.0	Great Lakes	Chicago	99	.63628	2400	1527	600
Item:	Pipe, Steel (Black Iron or Galvanized), 1¼ to 4"							LF
02-72	122.2	Crane,Ind.	Cincinnati	100	.65466	1705	116	220
05-72	124.6	Crane,Ind.	Cincinnati	100	.61776	3740	2310	520
05-72	124.6	Crane,Ind.	Cincinnati	100	.61776	2600	1606	200
05-72	124.6	Crane,Ind.	Cincinnati	100	.61776	1920	1186	240
02-72	122.2	Phil,Pa.	Phil,Pa.	114	.57427	4500	2584	500
05-72	125.4	L.A.	L.A.	115	.55475	7501	4161	840
03-72	123.0	Memphis	Atlanta	90	.72267	80	58	40
12-72	129.5	L.A.	L.A.	115	.53718	1892	1016	180
08-71	116.5	Corpus	Dallas	85	.80788	630	509	126
08-71	116.5	Corpus	Dallas	85	.80788	3465	2799	450
06-68	85.4	Wash,DC	Baltimore	97	.97029	360	349	100
06-68	85.4	Wash,DC	Baltimore	97	.97029	487	473	200
03-72	123.0	Dallas	Dallas	85	.76518	698	534	80
10-72	128.7	Great Lakes	Chicago	99	.62788	1900	1193	200
10-72	128.7	Great Lakes	Chicago	99	.62788	3000	1884	600

Category 9: H.V.A.C. (Heating, Ventilation & Air Conditioning)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Air Conditioning Equipment (Complete)							TONS
05-72	124.6	Crane,Ind.	Cincinnati	97	.66191	$6917	$4578	20
02-72	122.2	Crane,Ind.	Cincinnati	97	.67491	3900	2632	10
11-72	129.0	Crane,Ind.	Cincinnati	97	.63933	2530	1618	5
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	5540	3644	15
10-72	128.7	Jax, Fla.	Atlanta	97	.64083	11172	7159	50
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	575	452	3
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	5580	3670	12
02-72	122.2	Phil, Pa.	Phil, Pa.	100	.65466	8501	5565	20
03-72	123.0	Columbus	Cleveland	105	.61943	10115	6265	30
06-71	114.9	Corpus	Dallas	90	.77362	2947	2280	10
10-72	128.7	Great Lakes	Chicago	97	.64083	6220	3986	15
10-72	128.7	Great Lakes	Chicago	97	.64083	10879	6972	40
Item:	Insulated Ductwork							LBS
05-72	124.6	Crane,Ind.	Cincinnati	97	.66191	5918	3917	2150
02-72	122.2	Crane,Ind.	Cincinnati	97	.67491	8340	5628	5200
10-72	128.7	Jax, Fla.	Atlanta	97	.64083	6256	4009	4473
05-72	125.4	Jax, Fla.	Atlanta	97	.65769	5040	3315	2500
05-72	125.4	Jax, Fla.	Atlanta	97	.65769	7399	4866	5600
11-72	129.0	San Fran.	San Fran.	108	.57422	4827	2772	1857
Item:	Grilles and Registers							EA
05-72	124.6	Crane,Ind.	Cincinnati	97	.66191	1540	1019	22
02-72	122.2	Crane,Ind.	Cincinnati	97	.67491	2556	1725	60
10-72	128.7	Jax, Fla.	Atlanta	97	.64083	3628	2325	78
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	1060	697	18
06-72	125.4	Memphis	Atlanta	97	.65769	5263	3461	114

Category 9: H.V.A.C. (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Boilers, Oil or Gas (Complete)							HP
11-72	129.0	Crane,Ind.	Cincinnati	97	.63933	$8468	$5414	60
02-72	122.2	Phil, Pa.	Phil, Pa.	100	.65466	7086	4639	40
10-71	118.2	Charles,SC	Atlanta	97	.69775	7331	5115	50
10-72	128.7	Great Lakes	Chicago	97	.64083	10480	6716	80
Item:	Hot Air Furnaces (Gas) (Complete)							BTU
01-72	130.3	L.A.	L.A.	119	.51544	340	175	100000
01-72	120.3	L.A.	L.A.	119	.51544	265	137	25000
11-71	119.7	Corpus	Dallas	90	.76260	448	333	180000
06-71	114.9	Corpus	Dallas	90	.77362	300	232	120000
11-72	129.0	Crane,Ind.	Cincinnati	97	.63933	247	158	75000
10-71	118.2	Charles,SC	Atlanta	97	.69775	364	254	150000
09-72	127.9	Corpus	Dallas	90	.69499	518	360	200000
Item:	Exhaust Fans							HP
02-72	122.2	Crane,Ind.	Cincinnati	97	.67491	690	466	3
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	340	224	¼
06-72	125.4	Jax, Fla.	Atlanta	97	.65769	537	353	1
10-71	118.2	Charles,SC	Atlanta	97	.69775	547	382	2
06-71	114.9	Corpus	Dallas	90	.77362	383	296	½
11-71	119.7	Corpus	Dallas	90	.74260	496	368	1½
12-72	129.5	Phil, Pa.	Phil, Pa.	100	.61776	650	401	2

Category 10: Electrical

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Conduit, Large, 2½ to 4"							FT
09-72	127.9	Corpus	Dallas	87	.71895	$3475	$2498	1250
06-68	85.4	Wash, DC	Baltimore	90	1.0485	2700	2810	1800
10-72	128.7	Great Lakes	Chicago	108	.57556	1715	987	430
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	3603	2203	500
06-72	125.4	Jax, Fla.	Atlanta	98	.65098	876	570	100
11-72	129.0	Crane,Ind.	Cincinnati	105	.59062	6453	3811	1800
12-72	129.5	Phil, Pa.	Phil, Pa.	112	.55157	1700	938	360
05-72	123.0	L.A.	L.A.	114	.54656	2340	1279	520
12-71	120.5	Memphis	Atlanta	98	.67745	1480	1003	250
Item:	Conduit, Small, ½ to 2"							LF
06-72	121.3	Charles,SC	Atlanta	98	.67298	325	219	280
02-71	111.6	New York	New York	104	.68927	5550	3826	6000
09-72	127.9	Corpus	Dallas	87	.71895	417	300	150
01-72	121.3	Groton,CT	Boston	104	.63416	160	101	40
01-72	121.3	Pensacola	Atlanta	98	.67298	444	299	600
01-72	121.3	Pensacola	Atlanta	98	.67298	1757	1182	1830
10-72	128.7	Great Lakes	Chicago	108	.57556	4920	2832	5000
09-72	127.9	Great Lakes	Chiago	108	.57916	1000	579	1000
06-72	125.4	Great Lakes	Chicago	108	.59070	450	266	325
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	4188	2561	4000
11-72	129.0	Crane,Ind.	Cincinnati	105	.59062	2925	1728	2500
03-72	123.0	L.A.	L.A.	114	.57053	15244	8697	6040
09-72	127.9	L.A.	L.A.	114	.54867	400	219	200
08-72	127.0	Memphis	Atlanta	98	.64278	1280	823	1350
03-72	123.0	Memphis	Atlanta	98	.66368	3107	2662	4530

Category 10: Electrical (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Single Strand Wire, #14-#8							FT
01-72	121.3	Charles,SC	Atlanta	98	.67298	$157	$106	1000
01-72	121.3	Pensacola	Atlanta	98	.67298	835	562	6420
09-72	127.9	Great Lakes	Chicago	108	.57916	437	253	2500
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	2062	1261	15000
09-72	127.9	San Fran.	San Fran.	91	.68735	512	352	3080
08-72	127.0	Memphis	Atlanta	98	.64278	444	285	3400
12-71	120.5	Memphis	Atlanta	98	.67745	327	222	1650
03-72	123.0	Memphis	Atlanta	98	.66368	1351	897	11750
Item:	Stranded Wire, #6-#2/0							FT
01-73	130.3	Charles,SC	Atlanta	98	.62650	737	462	1100
01-73	120.3	L.A.	L.A.	114	.53857	2385	1284	3090
05-71	114.1	Corpus	Dallas	87	.71895	2250	1618	5000
08-71	116.5	Corpus	Dallas	87	.78930	5320	4199	20000
01-72	121.3	Groton, CT	Boston	104	.63416	430	273	200
02-72	122.2	Pensacola	Atlanta	98	.66802	4830	3227	15000
05-72	124.6	Dallas	Dallas	87	.73799	2240	1653	4000
11-72	129.0	Crane,Ind.	Cincinnati	105	.59062	3109	1836	6500
06-72	125.4	Jax, Fla.	Atlanta	98	.65098	1305	850	1500
09-72	127.9	L.A.	L.A.	114	.54867	4800	2634	10000
Item:	Stranded Wire, #3/0-500MCM							FT
02-71	111.6	New York	New York	104	.68927	9748	6719	7600
01-72	121.3	Groton, CT	Boston	104	.63416	2730	1731	700
06-68	85.4	Wash, DC	Baltimore	90	1.04085	4800	4996	6200
10-72	128.7	Great Lakes	Chicago	108	.57556	3810	2193	1500
10-72	128.7	Great Lakes	Chicago	108	.57556	15000	8633	9500
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	7165	4381	5000

Category 10: Electrical (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
05-72	125.4	Jax, Fla.	Atlanta	98	.65098	$3201	$2084	2250
12-72	129.5	Phil, Pa.	Phil, Pa.	112	.55157	5850	3227	2600
12-72	129.5	Phil, Pa.	Phil, Pa.	112	.55157	1750	965	50
03-72	123.0	L.A.	L.A.	114	.57053	5068	2891	2400
Item:	Light Fixtures							EA
01-73	130.3	Charles,SC	Atlanta	98	.62650	202	127	4
08-72	127.0	New Orleans	New Orleans	98	.64278	1192	766	20
05-71	114.1	Corpus	Dallas	87	.80591	1140	919	24
09-72	127.9	Corpus	Dallas	87	.69499	2808	2019	44
06-71	114.9	Corpus	Dallas	87	.80030	5249	4201	110
11-71	119.7	Corpus	Dallas	87	.76820	8352	6416	160
03-72	123.0	Dallas	Dallas	87	.74759	1950	1458	34
08-72	127.0	Great Lakes	Chicago	108	.58326	4256	2482	60
09-72	127.9	Great Lakes	Chicago	108	.57916	359	208	6
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	9546	5837	145
12-72	129.5	Phil, Pa.	Phil, Pa.	112	.55157	1160	640	10
12-72	129.5	San Fran.	San Fran.	91	.68149	4402	3000	83
05-72	123.0	L.A.	L.A.	114	.57053	10250	4848	120
08-72	127.0	Memphis	Atlanta	98	.64278	627	403	15
Item:	Receptacles, Switches							EA
08-72	127.0	New Orleans	New Orleans	98	.64278	217	139	20
09-72	127.9	San Fran.	San Fran.	91	.68735	774	532	72
08-72	127.0	Memphis	Atlanta	98	.64278	573	368	50
08-72	127.0	Memphis	Atlanta	98	.64278	85	55	8
03-72	123.0	L.A.	L.A.	114	.57053	3039	1734	158
03-72	123.0	Jax, Fla.	Atlanta	98	.66368	2218	1472	132
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	2012	1230	110

Category 10: Electrical (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Distribution Panels							CIRCUITS
02-71	111.6	New York	New York	104	.68927	$474	$327	20
05-71	114.1	Corpus	Dallas	87	.71895	421	303	16
08-71	116.5	Corpus	Dallas	87	.78930	537	424	28
09-71	116.5	Corpus	Dallas	87	.78930	930	734	36
01-72	121.3	Groton,CT	Boston	104	.63416	755	479	30
01-72	121.3	Groton,CT	Boston	104	.63416	700	444	24
01-72	121.3	Pensacola	Atlanta	98	.67298	300	202	8
09-72	127.9	Great Lakes	Chicago	108	.57916	920	533	30
05-72	124.6	Crane,Ind.	Cincinnati	105	.61148	570	348	20
11-72	129.0	Crane,Ind.	Cincinnati	105	.59062	1277	754	42
Item:	Transformers (Indoor)							KVA
12-72	129.5	San Fran.	San Fran.	91	.67884	1622	1101	45
06-72	121.3	Groton,CT	Boston	98	.67298	2500	1682	100
02-72	122.2	Pensacola	Atlanta	98	.66802	1038	693	30
11-72	129.0	Crane,Ind.	Cincinnati	105	.59062	2646	1563	75
10-72	128.7	Jax, Fla.	Atlanta	98	.63429	890	565	15
09-72	127.9	Corpus	Dallas	87	.71895	472	339	9

Category 11: Specialities

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Fire Protection Sprinkler System, per head							EA
10-71	118.2	Charles,SC	Atlanta	95	.71244	$19120	$13622	432
11-71	119.7	Corpus	Dallas	87	.76820	11525	8853	190
06-72	125.4	Jax, Fla.	Atlanta	95	.67154	7157	4806	110
11-72	129.0	San Fran.	San Fran.	103	.60209	24710	14879	362
03-72	123.0	Memphis	Atlanta	95	.68464	6035	4232	80

Category 12: Exterior

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Asphalt Paving (Including Base)							SY
06-72	125.4	New Orleans	New Orleans	80	.79744	$11914	$9501	3655
06-72	125.4	Gulfport,MS	New Orleans	80	.79744	3320	2648	673
06-72	125.4	Gulfport,MS	New Orleans	80	.79744	3937	3155	903
03-72	123.0	L.A.	L.A.	103	.63146	6250	3947	1314
04-71	113.3	L.A.	L.A.	103	.68552	10200	6992	2778
05-72	124.6	Seattle	Seattle	94	.68304	876	598	120
08-71	116.5	Corpus	Dallas	83	.82734	13490	11161	3800
11-71	119.7	Corpus	Dallas	83	.80522	10650	8576	3000
06-71	114.9	Corpus	Dallas	83	.83886	7250	6082	2900
06-71	114.9	Corpus	Dallas	83	.83886	6979	5854	2290
Item:	Curbs and Gutters							FT
06-72	125.4	Gulfport,MS	New Orleans	80	.79744	7548	5019	1685
06-72	125.4	Gulfport,MS	New Orleans	80	.79744	1842	1469	526
08-72	127.0	Newport,RI	Boston	106	.59426	9563	5683	2008
04-71	113.3	L.A.	L.A.	103	.68552	5740	3935	1640
08-71	116.5	Corpus	Dallas	83	.82734	1653	1368	570
11-71	119.7	Corpus	Dallas	83	.80522	2913	2346	800
11-72	129.0	Crane,Ind.	Cincinnati	111	.55870	1948	1088	410
06-72	125.4	Boston	Boston	106	.60185	6730	4050	1196
Item:	Sidewalks							SF
06-72	125.4	Gulfport,MS	New Orleans	80	.79744	1805	1439	1425
06-72	125.4	Boston	Boston	106	.60185	3069	1847	2495
08-71	116.5	Corpus	Dallas	83	.82734	768	635	640
11-71	119.7	Corpus	Dallas	83	.80522	480	387	400
06-71	114.9	Corpus	Dallas	83	.83886	1854	1555	1800
11-72	129.0	Crane,Ind.	Cincinnati	111	.55870	1935	1081	955

Category 12: Exterior (continued)

Month	Ip	City	Index City	Ig	K	Given Cost	Base Cost	Units
Item:	Fine Grade Grass Seed and Fertilizer							SY
08-72	127.0	Newport,RI	Boston	106	.59426	$1043	$620	1400
05-72	125.4	Boston	Boston	106	.60185	1196	720	2700
02-73	131.1	Phil, Pa.	Phil, Pa.	101	.60418	1000	604	560
11-72	129.0	San Fran.	San Fran.	107	.57958	1465	849	3900
08-71	116.5	Corpus	Dallas	83	.82734	720	596	890
06-71	114.9	Corpus	Dallas	83	.83886	724	607	2000
05-72	124.6	Dallas	Dallas	83	.77356	648	501	400
Item:	Chain Link Fence, 6' High							SY
09-72	127.9	Gulfport,MS	New Orleans	80	.78186	7663	5991	1780
07-72	126.2	L.A.	L.A.	103	.61545	1804	1110	312
06-72	125.4	L.A.	L.A.	103	.61938	19132	11850	4525
02-72	122.2	San Fran.	San Fran.	107	.61184	21705	13280	7560
12-72	129.5	San Fran.	San Fran.	107	.57735	5927	3422	900
11-72	129.0	Crane,Ind.	Cincinnati	111	.55870	14886	8317	2500

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
9.000	164.000	1.000	245.066	-81.066	.669
261.000	1394.000	1.000	1418.761	-24.761	.983
325.000	2055.000	1.000	1657.960	397.040	1.239
120.000	919.000	1.000	807.618	111.382	1.138
350.000	1734.000	1.000	1744.920	-10.920	.994
282.000	1323.000	1.000	1499.877	-176.877	.882
100.000	679.000	1.000	711.557	-32.557	.954
20.000	242.000	1.000	304.017	-62.017	.796
30.000	483.000	1.000	356.998	126.002	1.353
460.000	1794.000	1.000	2084.305	-290.305	.861
750.000	2733.000	1.000	2641.315	91.685	1.035
550.000	1903.000	1.000	2309.577	-406.577	.824
200.000	984.000	1.000	1168.574	-184.574	.842
170.000	1479.000	1.000	1037.583	441.417	1.425
51.000	415.000	1.000	466.361	-51.361	.890
161.000	716.000	1.000	997.264	-281.264	.718
500.000	2625.000	1.000	2190.248	434.752	1.198
50.000			461.212		
100.000			711.557		
150.000			947.344		
200.000			1168.574		
250.000			1375.247		
300.000			1567.362		
350.000			1744.920		
400.000			1907.920		
450.000			2056.363		
500.000			2190.248		
550.000			2309.577		
600.000			2414.347		
650.000			2504.561		
700.000			2580.216		
750.000			2641.315		
800.000			2687.856		

CODE NAME POLYNOMIAL CURVE FIT
EXCAVATION

ORDER	OBSERVATIONS
2	17

0	1.963094E+02
1	5.443620E+00
2	-2.911483E-03

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
3.000	225.000	1.000	230.412	-5.412	.977
4.000	392.000	1.000	321.068	70.932	1.221
20.000	2024.000	1.000	1755.624	268.376	1.153
30.000	2901.000	1.000	2636.991	264.009	1.100
35.000	4044.000	1.000	3073.282	970.718	1.316
40.000	2375.000	1.000	3506.643	-1131.643	.677
50.000	4125.000	1.000	4364.580	-239.580	.945
60.000	4806.000	1.000	5210.801	-404.801	.922
90.000	6810.000	1.000	7679.173	-869.173	.887
293.000	19775.000	1.000	21611.195	-1836.195	.915
157.000	12905.000	1.000	12811.179	93.821	1.007
600.000	32082.000	1.000	33509.430	-1427.430	.957
210.000	16094.000	1.000	16498.276	-404.276	.975
140.000	13714.000	1.000	11558.818	2155.182	1.186
450.000	29620.000	1.000	29075.445	544.555	1.019
528.000	33661.000	1.000	31710.084	1950.916	1.062
50.000			4364.580		
100.000			8478.533		
150.000			12299.601		
200.000			15827.786		
250.000			19063.086		
300.000			22005.502		
350.000			24655.034		
400.000			27011.681		
450.000			29075.445		
500.000			30846.324		
550.000			32324.319		
600.000			33509.430		
650.000			34401.656		
700.000			35000.998		

CODE NAME POLYNOMIAL CURVE FIT
FDN CONCRETE

ORDER	OBSERVATIONS
2	16

0	-4.225724E+01
1	9.106558E+01
2	-5.857684E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
67.000	586.000	1.000	633.240	-45.240	.929
330.000	1949.000	1.000	1882.121	66.879	1.036
150.000	1025.000	1.000	988.870	36.130	1.037
675.000	3166.000	1.000	3174.162	-8.162	.997
110.000	1133.000	1.000	810.002	322.998	1.399
460.000	2309.000	1.000	2503.567	-194.567	.922
127.000	897.000	1.000	884.509	12.491	1.014
500.000	2825.000	1.000	2671.620	153.380	1.057
135.000	788.000	1.000	920.369	-132.369	.856
120.000	642.000	1.000	853.542	-211.542	.752
50.000			568.614		
100.000			767.326		
150.000			983.870		
200.000			1227.205		
250.000			1476.292		
300.000			1730.092		
350.000			1982.564		
400.000			2227.669		
450.000			2459.368		
500.000			2671.620		
550.000			2858.385		
600.000			3013.625		
650.000			3131.299		
700.000			3205.368		
750.000			3229.792		

CODE NAME POLYNOMIAL CURVE FIT
COMPACT FILL

ORDER	OBSERVATIONS
3	10

0	3.957737E+02
1	3.007836E+00
2	6.962187E-03
3	-8.052951E-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
40.000	5536.000	1.000	5452.332	83.668	1.015
56.000	5905.000	1.000	6216.714	-311.714	.950
65.000	6855.000	1.000	6601.605	253.395	1.038
90.000	7476.000	1.000	7500.460	-24.460	.997
180.000	8662.000	1.000	8662.889	-.889	1.000
10.000			3742.655		
20.000			4352.614		
30.000			4922.506		
40.000			5452.332		
50.000			5942.091		
60.000			6391.783		
70.000			6801.409		
80.000			7170.968		
90.000			7500.460		
100.000			7789.886		
110.000			8039.245		
120.000			8248.537		
130.000			8417.762		
140.000			8546.921		
150.000			8636.013		
160.000			8685.038		
170.000			8693.997		
180.000			8662.889		

CODE NAME POLYNOMIAL CURVE FIT
STR CONCRETE

ORDER	OBSERVATIONS
2	5

0	3.092629E+03
1	6.700592E+01
2	-2.003335E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
.500	1195.000	1.000	1484.104	-289.104	.805
2.750	3242.000	1.000	3555.582	-313.582	.912
4.500	5820.000	1.000	4925.468	894.532	1.182
11.000	8371.000	1.000	8467.106	-96.106	.989
14.000	9366.000	1.000	9451.598	-85.598	.991
17.500	10557.000	1.000	10239.710	317.290	1.031
20.000	10120.000	1.000	10637.323	-517.323	.951
22.500	10332.000	1.000	10954.101	-622.101	.943
25.000	11575.000	1.000	11240.283	334.717	1.030
31.000	12989.000	1.000	12102.913	886.087	1.073
35.000	12575.000	1.000	13083.812	-508.812	.961
2.000			2905.371		
4.000			4554.441		
6.000			5946.003		
8.000			7105.778		
10.000			8059.487		
12.000			8832.853		
14.000			9451.598		
16.000			9941.443		
18.000			10328.111		
20.000			10637.323		
22.000			10894.801		
24.000			11126.267		
26.000			11357.443		
28.000			11614.050		
30.000			11921.811		
32.000			12306.448		
34.000			12793.682		
36.000			13409.236		
38.000			14178.831		
40.000			15128.168		

CODE NAME POLYNOMIAL CURVE FIT
STRUCT STEEL

ORDER	OBSERVATIONS
3	11

0	9.730690E+02
1	1.041245E+03
2	-3.861909E+01
3	5.358726E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
544.000	337.000	1.000	286.759	50.241	1.175
605.000	296.000	1.000	319.364	-23.364	.927
900.000	414.000	1.000	466.790	-52.790	.887
1200.000	516.000	1.000	599.280	-83.280	.861
1000.000	580.000	1.000	512.906	67.094	1.131
2064.000	970.000	1.000	882.634	87.366	1.099
2500.000	925.000	1.000	970.266	-45.266	.953
250.000			119.418		
500.000			262.789		
750.000			393.952		
1000.000			512.906		
1250.000			619.653		
1500.000			714.192		
1750.000			796.522		
2000.000			866.645		
2250.000			924.560		
2500.000			970.266		
2750.000			1003.765		
3000.000			1025.056		

CODE NAME POLYNOMIAL CURVE FIT
WOOD FRAMING

ORDER	OBSERVATIONS
2	7

0	-3.616023E+01
1	6.467307E-01
2	-9.766404E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
4800.000	1191.000	1.000	1504.069	-313.069	.792
1600.000	709.000	1.000	673.927	35.073	1.052
1900.000	865.000	1.000	760.574	104.426	1.137
258.000	197.000	1.000	263.983	-66.983	.746
450.000	287.000	1.000	324.872	-37.872	.883
950.000	462.000	1.000	479.930	-17.930	.963
950.000	654.000	1.000	479.930	174.070	1.363
7000.000	2134.000	1.000	1954.336	179.664	1.092
352.000	232.000	1.000	293.887	-61.887	.789
550.000	288.000	1.000	356.290	-68.290	.808
478.000	252.000	1.000	333.690	-81.690	.755
160.000	148.000	1.000	232.616	-84.616	.636
2866.000	1149.000	1.000	1027.177	121.823	1.119
4320.000	1163.000	1.000	1392.785	-229.785	.835
1821.000	1085.000	1.000	737.934	347.066	1.470
500.000			340.606		
1000.000			495.157		
1500.000			644.639		
2000.000			789.051		
2500.000			928.393		
3000.000			1062.665		
3500.000			1191.868		
4000.000			1316.001		
4500.000			1435.064		
5000.000			1549.058		
5500.000			1657.982		
6000.000			1761.836		
6500.000			1860.621		
7000.000			1954.336		
7500.000			2042.982		

CODE NAME POLYNOMIAL CURVE FIT
FLOOR TILE

ORDER OBSERVATIONS
2 15

0 1.809856E+02
1 3.243111E-01
2 -1.013933E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
2700.000	2081.000	1.000	2079.578	1.422	1.001
1810.000	1647.000	1.000	1757.234	-110.234	.937
936.000	1227.000	1.000	1221.547	5.453	1.004
1354.000	1476.000	1.000	1504.838	-28.838	.981
1737.000	1853.000	1.000	1720.803	132.197	1.077
250.000			648.978		
500.000			873.133		
750.000			1079.521		
1000.000			1268.142		
1250.000			1438.996		
1500.000			1592.082		
1750.000			1727.402		
2000.000			1844.954		
2250.000			1944.738		
2500.000			2026.756		
2750.000			2091.006		
3000.000			2137.489		
3250.000			2166.205		
3500.000			2177.154		
3750.000			2170.335		
4000.000			2145.750		

CODE NAME POLYNOMIAL CURVE FIT
CARPETING

ORDER	OBSERVATIONS
2	5

0	4.070552E+02
1	1.003225E+00
2	-1.421378E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
14508.000	3054.000	1.000	3041.466	12.534	1.004
710.000	547.000	1.000	1236.785	-689.785	.442
694.000	2113.000	1.000	1235.724	877.276	1.710
1810.000	959.000	1.000	1311.650	-352.650	.731
4120.000	1689.000	1.000	1487.753	201.247	1.135
10114.000	2130.000	1.000	2178.622	-48.622	.978
500.000			1222.908		
1000.000			1256.138		
1500.000			1290.122		
2000.000			1325.042		
2500.000			1361.083		
3000.000			1398.427		
3500.000			1437.260		
4000.000			1477.763		
4500.000			1520.122		
5000.000			1564.518		
5500.000			1611.137		
6000.000			1660.162		
6500.000			1711.775		
7000.000			1766.161		
7500.000			1823.504		
8000.000			1883.987		
8500.000			1947.793		
9000.000			2015.106		
9500.000			2086.110		
10000.000			2160.989		
10500.000			2239.925		
11000.000			2323.103		
11500.000			2410.706		
12000.000			2502.917		

CODE NAME POLYNOMIAL CURVE FIT
UNDERLAYMENT

ORDER	OBSERVATIONS
3	6

0	1.190248E+03
1	6.487371E-02
2	7.721412E-07
3	2.447900E-10

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
996.000	1696.000	1.000	2103.337	-407.337	.806
4000.000	5831.000	1.000	5878.428	-47.428	.992
260.000	629.000	1.000	712.823	-83.823	.882
100.000	409.000	1.000	386.288	22.712	1.059
520.000	2086.000	1.000	1224.970	861.030	1.703
2600.000	4593.000	1.000	4498.895	94.105	1.021
325.000	722.000	1.000	843.003	-121.003	.856
900.000	1453.000	1.000	1932.358	-479.358	.752
1441.000	3280.000	1.000	2855.177	424.823	1.149
830.000	1542.000	1.000	1805.720	-263.720	.854
250.000			692.668		
500.000			1186.386		
750.000			1658.962		
1000.000			2110.394		
1250.000			2540.683		
1500.000			2949.830		
1750.000			3337.833		
2000.000			3704.693		
2250.000			4050.411		
2500.000			4374.985		
2750.000			4678.416		
3000.000			4960.705		
3250.000			5221.850		
3500.000			5461.852		
3750.000			5680.712		
4000.000			5878.428		

CODE NAME POLYNOMIAL CURVE FIT

CERAMIC TILE

ORDER	OBSERVATIONS
2	10

0	1.778065E+02
1	2.101731E+00
2	-1.691440E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1328.000	642.000	1.000	771.767	-129.767	.832
2600.000	1222.000	1.000	1197.410	24.590	1.021
100.000	82.000	1.000	113.719	-31.719	.721
3600.000	1368.000	1.000	1443.758	-75.758	.948
4800.000	1787.000	1.000	1745.859	41.141	1.024
5000.000	1772.000	1.000	1804.892	-32.892	.982
3000.000	1149.000	1.000	1300.500	-151.500	.884
650.000	559.000	1.000	447.117	111.883	1.250
2040.000	991.000	1.000	1032.913	-41.913	.959
515.000	359.000	1.000	371.634	-12.634	.966
1900.000	849.000	1.000	986.829	-137.829	.860
1400.000	638.000	1.000	801.478	-163.478	.796
2100.000	1015.000	1.000	1051.984	-36.984	.965
2973.000	1493.000	1.000	1293.808	199.192	1.154
4251.000	1621.000	1.000	1599.749	21.251	1.013
2000.000	1122.000	1.000	1019.977	102.023	1.100
1400.000	1000.000	1.000	801.478	198.522	1.248
1976.000	1128.000	1.000	1012.128	115.872	1.114
250.000			211.637		
500.000			363.003		
750.000			500.547		
1000.000			625.384		
1250.000			738.630		
1500.000			841.401		
1750.000			934.811		
2000.000			1019.977		
2250.000			1098.013		
2500.000			1170.035		
2750.000			1237.159		
3000.000			1300.500		
3250.000			1361.173		
3500.000			1420.294		
3750.000			1478.979		

CODE NAME POLYNOMIAL CURVE FIT
ACCOUST TILE

ORDER	OBSERVATIONS
3	18

0	4.533360E+01
1	6.965757E-01
2	-1.284232E-04
3	1.189807E-08

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1059.000	866.000	1.000	785.777	80.223	1.102
9600.000	6533.000	1.000	6322.503	210.497	1.033
3000.000	2617.000	1.000	1929.950	687.050	1.356
160.000	73.000	1.000	278.576	-205.576	.262
2200.000	1259.000	1.000	1450.240	-191.240	.868
200.000	247.000	1.000	300.837	-53.837	.821
7220.000	3553.000	1.000	4649.078	-1096.078	.764
5000.000	3334.000	1.000	3179.095	154.905	1.049
8300.000	5810.000	1.000	5395.944	414.056	1.077
500.000			468.706		
1000.000			752.049		
1500.000			1039.845		
2000.000			1332.094		
2500.000			1628.796		
3000.000			1929.950		
3500.000			2235.557		
4000.000			2545.617		
4500.000			2860.130		
5000.000			3179.095		
5500.000			3502.514		
6000.000			3830.385		
6500.000			4162.709		
7000.000			4499.485		
7500.000			4840.715		
8000.000			5186.397		
8500.000			5536.532		
9000.000			5891.120		
9500.000			6250.160		
10000.000			6613.654		

CODE NAME POLYNOMIAL CURVE FIT
LT CONC SLAB

ORDER	OBSERVATIONS
2	9

0	1.898152E+02
1	5.533283E-01
2	8.905556E-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1067.000	2293.000	1.000	2376.156	-83.156	.965
5600.000	10365.000	1.000	10957.311	-592.311	.946
4133.000	7942.000	1.000	8466.213	-524.213	.938
2700.000	5724.000	1.000	5768.610	-44.610	.992
2800.000	6272.000	1.000	5965.335	306.665	1.051
6035.000	11467.000	1.000	11643.373	-176.373	.985
5467.000	11809.000	1.000	10742.747	1066.253	1.099
1450.000	3250.000	1.000	3202.255	47.745	1.015
500.000			1118.934		
1000.000			2229.725		
1500.000			3308.725		
2000.000			4355.932		
2500.000			5371.346		
3000.000			6354.969		
3500.000			7306.798		
4000.000			8226.836		
4500.000			9115.081		
5000.000			9971.534		
5500.000			10796.194		
6000.000			11589.062		
6500.000			12350.138		
7000.000			13079.422		
7500.000			13776.913		

CODE NAME POLYNOMIAL CURVE FIT
BRICK WALLS

ORDER	OBSERVATIONS
2	8

0	-2.365024E+01
1	2.314960E+00
2	-6.358471E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
8850.000	10089.000	1.000	10034.471	54.529	1.005
3097.000	4021.000	1.000	3789.812	231.188	1.061
5310.000	6097.000	1.000	6264.691	-167.691	.973
131.000	274.000	1.000	330.170	-56.170	.830
1858.000	2248.000	1.000	2364.472	-116.472	.951
3540.000	4142.000	1.000	4292.517	-150.517	.965
607.000	1071.000	1.000	896.399	174.601	1.195
300.000	387.000	1.000	531.687	-144.687	.728
265.000	431.000	1.000	489.996	-58.996	.880
442.000	532.000	1.000	700.599	-168.599	.759
1000.000	1920.000	1.000	1360.724	559.276	1.411
532.000	651.000	1.000	807.462	-156.462	.806
500.000			769.483		
1000.000			1360.724		
1500.000			1947.321		
2000.000			2529.275		
2500.000			3106.585		
3000.000			3679.252		
3500.000			4247.275		
4000.000			4810.655		
4500.000			5369.392		
5000.000			5923.485		
5500.000			6472.935		
6000.000			7017.741		
6500.000			7557.904		
7000.000			8093.424		
7500.000			8624.300		
8000.000			9150.532		
8500.000			9672.121		
9000.000			10189.067		

CODE NAME POLYNOMIAL CURVE FIT
CONCRETE BLK

ORDER	OBSERVATIONS
2	12

0	1.735994F+02
1	1.196411E+00
2	-9.284855F-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1900.000	1073.000	1.000	1131.008	-58.008	.949
5400.000	2003.000	1.000	1770.949	232.051	1.131
820.000	793.000	1.000	684.069	108.931	1.159
220.000	291.000	1.000	264.209	26.791	1.101
1230.000	856.000	1.000	894.079	-38.079	.957
1400.000	742.000	1.000	965.537	-223.537	.768
4164.000	1474.000	1.000	1469.743	4.257	1.003
5300.000	1512.000	1.000	1734.596	-222.596	.872
3300.000	1033.000	1.000	1366.689	-333.689	.756
6300.000	1877.000	1.000	2237.511	-360.511	.839
1857.000	1185.000	1.000	1119.115	65.885	1.059
3880.000	1937.000	1.000	1431.898	505.102	1.353
1800.000	1195.000	1.000	1102.724	92.276	1.084
7000.000	3019.000	1.000	2817.871	201.129	1.071
500.000			478.294		
1000.000			783.209		
1500.000			1003.719		
2000.000			1157.164		
2500.000			1260.884		
3000.000			1332.219		
3500.000			1388.510		
4000.000			1447.096		
4500.000			1525.318		
5000.000			1640.516		
5500.000			1810.030		
6000.000			2051.200		

CODE NAME POLYNOMIAL CURVE FIT
GYPSUM BOARD

ORDER	OBSERVATIONS
3	14

0	7.163268E+01
1	9.266279E-01
2	-2.381716E-04
3	2.312026E-08

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
4000.000	284.000	1.000	334.048	-50.048	.850
5660.000	411.000	1.000	432.935	-21.935	.949
4950.000	432.000	1.000	376.775	55.225	1.147
2000.000	266.000	1.000	246.155	19.845	1.081
3272.000	332.000	1.000	310.312	21.688	1.070
2400.000	228.000	1.000	272.521	-44.521	.837
1750.000	262.000	1.000	225.426	36.574	1.162
1000.000	121.000	1.000	137.828	-16.828	.878
250.000			1.241		
500.000			53.076		
750.000			98.432		
1000.000			137.828		
1250.000			171.780		
1500.000			200.807		
1750.000			225.426		
2000.000			246.155		
2250.000			263.511		
2500.000			278.012		
2750.000			290.176		
3000.000			300.519		
3250.000			309.561		
3500.000			317.818		
3750.000			325.808		
4000.000			334.048		
4250.000			343.057		
4500.000			353.352		
4750.000			365.450		
5000.000			379.869		
5250.000			397.127		
5500.000			417.741		
5750.000			442.230		
6000.000			471.109		

CODE NAME POLYNOMIAL CURVE FIT
INSULATION

ORDER	OBSERVATIONS
3	8

0	-5.758961E+01
1	2.500051E-01
2	-6.010884E-05
3	5.521234E-09

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
80.000	1821.000	1.000	1592.157	228.843	1.144
82.000	1405.000	1.000	1619.132	-214.132	.868
200.000	3106.000	1.000	3189.593	-83.593	.974
348.000	5777.000	1.000	5100.699	676.301	1.133
375.000	4744.000	1.000	5442.310	-698.310	.872
516.000	8018.000	1.000	7191.005	826.995	1.115
522.000	6528.000	1.000	7264.104	-736.104	.899
25.000			845.666		
50.000			1186.097		
75.000			1524.667		
100.000			1861.375		
125.000			2196.222		
150.000			2529.207		
175.000			2860.331		
200.000			3189.593		
225.000			3516.994		
250.000			3842.534		
275.000			4165.212		
300.000			4488.029		
325.000			4807.984		
350.000			5126.078		
375.000			5442.310		
400.000			5756.681		
425.000			6069.190		
450.000			6379.838		
475.000			6688.624		
500.000			6995.549		
525.000			7300.613		
550.000			7603.815		
575.000			7905.156		
600.000			8204.635		

CODE NAME POLYNOMIAL CURVE FIT
ROOF REMOVAL

ORDER	OBSERVATIONS
2	7

0	5.033728E+02
1	1.372894E+01
2	-1.489166E-03

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
80.000	3720.000	1.000	3797.280	-77.280	.980
200.000	6120.000	1.000	5894.402	225.598	1.038
280.000	7012.000	1.000	6970.702	41.298	1.006
348.000	6920.000	1.000	7683.157	-763.157	.901
375.000	8488.000	1.000	7914.458	573.542	1.072
25.000			2642.527		
50.000			3182.499		
75.000			3697.330		
100.000			4187.023		
125.000			4651.577		
150.000			5090.991		
175.000			5505.266		
200.000			5894.402		
225.000			6258.399		
250.000			6597.257		
275.000			6910.975		
300.000			7199.555		
325.000			7462.995		
350.000			7701.296		
375.000			7914.458		
400.000			8102.481		
425.000			8265.364		
450.000			8403.109		
475.000			8515.714		
500.000			8603.180		
525.000			8665.507		
550.000			8702.695		
575.000			8714.743		
600.000			8701.653		

CODE NAME　　POLYNOMIAL CURVE FIT
SHINGLE ROOF

ORDER	OBSERVATIONS
2	5

0	2.077417E+03
1	2.310719E+01
2	-2.011133E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
15.000	1355.000	1.000	1191.568	163.432	1.137
34.000	2805.000	1.000	2265.192	539.808	1.238
40.000	1746.000	1.000	2576.396	-830.396	.678
49.000	2954.000	1.000	3018.984	-64.984	.978
90.000	6159.000	1.000	4688.293	1470.707	1.314
82.000	3435.000	1.000	4405.239	-970.239	.780
110.000	5434.000	1.000	5311.626	122.374	1.023
128.000	6524.000	1.000	5775.367	748.633	1.130
130.000	6500.000	1.000	5821.497	678.503	1.117
126.000	5657.000	1.000	5728.182	-71.182	.988
200.000	7340.000	1.000	6839.293	501.707	1.073
189.000	6048.000	1.000	6748.296	-700.296	.896
50.000	3700.000	1.000	3066.396	633.604	1.207
125.000	4267.000	1.000	5704.190	-1437.190	.748
120.000	5716.000	1.000	5580.200	135.800	1.024
3.000	319.000	1.000	441.962	-122.962	.722
74.000	3639.000	1.000	4102.080	-463.080	.887
82.000	4071.000	1.000	4405.239	-334.239	.924
15.000			1191.568		
30.000			2050.408		
45.000			2825.826		
60.000			3521.496		
75.000			4141.094		
90.000			4688.293		
105.000			5166.771		
120.000			5580.200		
135.000			5932.257		
150.000			6226.616		
165.000			6466.952		
180.000			6656.941		
195.000			6800.257		
210.000			6900.575		
225.000			6961.571		
240.000			6986.919		

CODE NAME POLYNOMIAL CURVE FIT
BUILTUP ROOF

ORDER	OBSERVATIONS
3	18

0	2.456298E+02
1	6.604746E+01
2	-2.017170E-01
3	1.814814E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1000.000	1311.000	1.000	809.967	501.033	1.619
160.000	205.000	1.000	-16.894	221.894	-12.134
720.000	176.000	1.000	554.082	-378.082	.318
900.000	276.000	1.000	720.845	-444.845	.383
4000.000	2294.000	1.000	2313.130	-19.130	.992
2000.000	1650.000	1.000	1562.743	87.257	1.056
3200.000	2120.000	1.000	2133.801	-13.801	.994
1800.000	1478.000	1.000	1432.326	45.674	1.032
250.000			80.194		
500.000			339.184		
750.000			582.442		
1000.000			809.967		
1250.000			1021.760		
1500.000			1217.820		
1750.000			1398.148		
2000.000			1562.743		
2250.000			1711.605		
2500.000			1844.735		
2750.000			1962.133		
3000.000			2063.797		
3250.000			2149.729		
3500.000			2219.929		
3750.000			2274.396		
4000.000			2313.130		

CODE NAME POLYNOMIAL CURVE FIT
VINYL PAPER

ORDER	OBSERVATIONS
2	8

0	-1.945296E+02
1	1.130358E+00
2	-1.258607E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
2000.000	629.000	1.000	1211.536	-582.536	.519
7500.000	3252.000	1.000	2293.834	958.166	1.418
10000.000	3665.000	1.000	2779.501	885.499	1.319
1500.000	576.000	1.000	1112.202	-536.202	.518
16900.000	3658.000	1.000	4099.550	-441.550	.892
6000.000	1784.000	1.000	2000.548	-216.548	.892
5800.000	1617.000	1.000	1961.337	-344.337	.824
2300.000	1383.000	1.000	1271.061	111.939	1.088
21000.000	3872.000	1.000	4869.749	-997.749	.795
35600.000	7898.000	1.000	7526.579	371.421	1.049
4000.000	1472.000	1.000	1607.300	-135.300	.916
28000.000	5755.000	1.000	6160.296	-405.296	.934
6000.000	2453.000	1.000	2000.548	452.452	1.226
6000.000	2424.000	1.000	2000.548	423.452	1.212
24500.000	5958.000	1.000	5518.873	439.127	1.080
2000.000	1229.000	1.000	1211.536	17.464	1.014
2500.000			1310.713		
5000.000			1804.238		
7500.000			2293.834		
10000.000			2779.501		
12500.000			3261.238		
15000.000			3739.045		
17500.000			4212.922		
20000.000			4682.870		
22500.000			5148.888		
25000.000			5610.977		
27500.000			6069.136		
30000.000			6523.365		
32500.000			6973.665		
35000.000			7420.035		
37500.000			7862.475		
40000.000			8300.986		

CODE NAME POLYNOMIAL CURVE FIT
EXT PAINTING

ORDER	OBSERVATIONS
2	16

0	8.132576E+02
1	1.997680E-01
2	-3.143700E-07

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
500.000	155.000	1.000	198.889	-43.889	.779
2000.000	318.000	1.000	342.406	-24.406	.929
20000.000	3096.000	1.000	2959.855	136.145	1.046
3579.000	583.000	1.000	511.787	71.213	1.139
33847.000	3649.000	1.000	5010.437	-1361.437	.728
4000.000	724.000	1.000	559.900	164.100	1.293
15500.000	1876.000	1.000	2217.948	-341.948	.846
2480.000	517.000	1.000	391.987	125.013	1.319
12000.000	1184.000	1.000	1660.549	-476.549	.713
2900.000	389.000	1.000	436.757	-47.757	.891
12000.000	1575.000	1.000	1660.549	-85.549	.948
2500.000	583.000	1.000	394.090	188.910	1.479
1500.000	229.000	1.000	292.607	-63.607	.783
10000.000	997.000	1.000	1357.887	-360.887	.734
39000.000	6155.000	1.000	5513.813	641.187	1.116
15000.000	2364.000	1.000	2136.713	227.287	1.106
23000.000	4725.000	1.000	3451.933	1273.067	1.369
3500.000	482.000	1.000	502.892	-20.892	.958
2500.000			394.090		
5000.000			678.851		
7500.000			1002.428		
10000.000			1357.887		
12500.000			1738.293		
15000.000			2136.713		
17500.000			2546.212		
20000.000			2959.855		
22500.000			3370.708		
25000.000			3771.836		
27500.000			4156.306		
30000.000			4517.183		
32500.000			4847.533		
35000.000			5140.421		
37500.000			5388.913		
40000.000			5586.074		

CODE NAME POLYNOMIAL CURVE FIT
INT PAINTING

ORDER	OBSERVATIONS
3	18

0	1.550793E+02
1	8.552947E-02
2	4.214794E-06
3	-7.396646E-11

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
16.000	2774.000	1.000	2428.283	345.717	1.142
1.000	253.000	1.000	144.022	108.978	1.757
12.000	1895.000	1.000	1878.181	16.819	1.009
4.000	624.000	1.000	649.175	-25.175	.961
23.000	3805.000	1.000	3287.652	517.348	1.157
45.000	5151.000	1.000	5132.526	18.474	1.004
8.000	853.000	1.000	1285.145	-432.145	.664
21.000	3304.000	1.000	3055.535	248.465	1.081
20.000	2294.000	1.000	2935.451	-641.451	.781
1.000	255.000	1.000	144.022	110.978	1.771
4.000	713.000	1.000	649.175	63.825	1.098
32.000	3982.000	1.000	4199.350	-217.350	.948
10.000	1633.000	1.000	1587.030	45.970	1.029
18.000	2954.000	1.000	2687.234	266.766	1.099
12.000	1524.000	1.000	1878.181	-354.181	.811
25.000	3436.000	1.000	3509.035	-73.035	.979
3.000			483.474		
6.000			972.527		
9.000			1437.429		
12.000			1878.181		
15.000			2294.783		
18.000			2687.234		
21.000			3055.535		
24.000			3399.685		
27.000			3719.685		
30.000			4015.534		
33.000			4287.233		
36.000			4534.782		
39.000			4758.180		
42.000			4957.428		
45.000			5132.526		
48.000			5283.473		

CODE NAME   POLYNOMIAL CURVE FIT
DOORS+FRAMES

ORDER	OBSERVATIONS
2	16

0	-2.972866E+01
1	1.750928E+02
2	-1.341689E+00

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
18.000	2183.000	1.000	2462.200	-279.200	.887
6.000	763.000	1.000	709.805	53.195	1.075
4.000	298.000	1.000	453.601	-155.601	.657
17.000	2438.000	1.000	2302.079	135.921	1.059
7.000	920.000	1.000	841.749	78.251	1.093
33.000	5200.000	1.000	5171.425	28.575	1.006
11.000	1534.000	1.000	1395.141	138.859	1.100
2.000			207.645		
4.000			453.601		
6.000			709.805		
8.000			976.254		
10.000			1252.951		
12.000			1539.893		
14.000			1837.082		
16.000			2144.518		
18.000			2462.200		
20.000			2790.129		
22.000			3128.305		
24.000			3476.726		
26.000			3835.395		
28.000			4204.310		
30.000			4583.471		
32.000			4972.879		
34.000			5372.533		
36.000			5782.434		
38.000			6202.582		
40.000			6632.975		

CODE NAME POLYNOMIAL CURVE FIT
ALUM WINDOWS

ORDER	OBSERVATIONS
2	7

0	-2.806530E+01
1	1.152934E+02
2	1.280815E+00

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
12.000	1080.000	1.000	1085.645	-5.645	.995
7.000	702.000	1.000	716.643	-14.643	.980
3.000	248.000	1.000	279.155	-31.155	.888
3.000	296.000	1.000	279.155	16.845	1.060
6.000	609.000	1.000	619.128	-10.128	.984
2.000	164.000	1.000	150.021	13.979	1.093
8.000	837.000	1.000	806.253	30.747	1.038
1.000			12.983		
2.000			150.021		
3.000			279.155		
4.000			400.384		
5.000			513.709		
6.000			619.128		
7.000			716.643		
8.000			806.253		
9.000			887.958		
10.000			961.758		
11.000			1027.654		
12.000			1085.645		
13.000			1135.731		
14.000			1177.912		
15.000			1212.189		

CODE NAME   POLYNOMIAL CURVE FIT

TOILET PART

ORDER	OBSERVATIONS
2	7

0	-1.319606E+02
1	1.488958E+02
2	-3.952388E+00

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
200.000	632.000	1.000	506.571	125.429	1.248
980.000	2207.000	1.000	2259.044	-52.044	.977
1200.000	2488.000	1.000	2474.245	13.755	1.006
400.000	857.000	1.000	988.023	-131.023	.867
124.000	272.000	1.000	340.075	-68.075	.800
100.000	384.000	1.000	290.274	93.726	1.323
75.000	163.000	1.000	240.003	-77.003	.679
700.000	1816.000	1.000	1720.765	95.235	1.055
50.000			191.487		
100.000			290.274		
150.000			395.611		
200.000			506.571		
250.000			622.221		
300.000			741.633		
350.000			863.877		
400.000			988.023		
450.000			1113.141		
500.000			1238.301		
550.000			1362.573		
600.000			1485.028		
650.000			1604.735		
700.000			1720.765		
750.000			1832.188		
800.000			1938.073		
850.000			2037.492		
900.000			2129.515		
950.000			2213.210		
1000.000			2287.650		
1050.000			2351.903		
1100.000			2405.039		
1150.000			2446.130		
1200.000			2474.245		

CODE NAME POLYNOMIAL CURVE FIT
WINDOW GLASS

ORDER	OBSERVATIONS
3	8

0	1.001313E+02
1	1.745104E+00
2	1.682175E-03
3	-1.239811E-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
15.000	1792.000	1.000	2441.247	-649.247	.734
22.000	3747.000	1.000	3326.792	420.208	1.126
28.000	4060.000	1.000	4085.831	-25.831	.994
32.000	4313.000	1.000	4591.857	-278.857	.939
19.000	3481.000	1.000	2947.273	533.727	1.181
2.000			796.664		
4.000			1049.677		
6.000			1302.690		
8.000			1555.702		
10.000			1808.715		
12.000			2061.728		
14.000			2314.741		
16.000			2567.754		
18.000			2820.767		
20.000			3073.779		
22.000			3326.792		
24.000			3579.805		
26.000			3832.818		
28.000			4085.831		
30.000			4338.844		
32.000			4591.857		
34.000			4844.869		
36.000			5097.882		
38.000			5350.895		
40.000			5603.908		

CODE NAME POLYNOMIAL CURVE FIT
PLUMB FIXT

ORDER	OBSERVATIONS
1	5

0	5.436510F+02
1	1.265064F+02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
4.000	1297.000	1.000	1675.898	-378.898	.774
6.000	2574.000	1.000	2267.841	306.159	1.135
19.000	3762.000	1.000	3770.735	-8.735	.998
13.000	3373.000	1.000	3317.633	55.367	1.017
2.000	741.000	1.000	892.605	-151.605	.830
8.000	2481.000	1.000	2702.018	-221.018	.918
3.000	1709.000	1.000	1310.269	398.731	1.304
2.000			892.605		
4.000			1675.898		
6.000			2267.841		
8.000			2702.018		
10.000			3012.014		
12.000			3231.412		
14.000			3393.799		
16.000			3532.757		
18.000			3681.873		
20.000			3874.731		
22.000			4144.914		
24.000			4526.009		
26.000			5051.600		
28.000			5755.270		
30.000			6670.606		

CODE NAME POLYNOMIAL CURVE FIT
MANHOLES

ORDER	OBSERVATIONS
3	7

0	-1.156248E+02
1	5.659460E+02
2	-3.231501E+01
3	6.996801E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
176.000	1522.000	1.000	1460.664	61.336	1.042
196.000	1453.000	1.000	1594.769	-141.769	.911
240.000	2224.000	1.000	1856.597	367.403	1.198
80.000	278.000	1.000	671.764	-393.764	.414
90.000	976.000	1.000	765.866	210.134	1.274
100.000	448.000	1.000	857.075	-409.075	.523
900.000	2934.000	1.000	2930.101	3.899	1.001
400.000	2375.000	1.000	2480.900	-105.900	.957
50.000	502.000	1.000	371.642	130.358	1.351
100.000	866.000	1.000	857.075	8.925	1.010
52.000	662.000	1.000	392.498	269.502	1.687
250.000	1909.000	1.000	1910.049	-1.049	.999
50.000			371.642		
100.000			857.075		
150.000			1271.387		
200.000			1620.428		
250.000			1910.049		
300.000			2146.100		
350.000			2334.434		
400.000			2480.900		
450.000			2591.351		
500.000			2671.636		
550.000			2727.608		
600.000			2765.116		
650.000			2790.013		
700.000			2808.148		
750.000			2825.374		
800.000			2847.540		
850.000			2880.499		
900.000			2930.101		

CODE NAME　　POLYNOMIAL CURVE FIT
CI PIPE 2-8

ORDER　OBSERVATIONS
3　12

0	-1.907653E+02
1	1.205688E+01
2	-1.656482E-02
3	7.801347E-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
90.000	279.000	1.000	493.281	-214.281	.566
972.000	5278.000	1.000	5375.187	-97.187	.982
252.000	949.000	1.000	1122.513	-173.513	.845
560.000	3027.000	1.000	3327.754	-300.754	.910
200.000	1338.000	1.000	857.296	480.704	1.561
670.000	4135.000	1.000	4133.084	1.916	1.000
750.000	5025.000	1.000	4638.719	386.281	1.083
400.000	2297.000	1.000	2100.461	196.539	1.094
500.000	2584.000	1.000	2863.706	-279.706	.902
50.000			441.005		
100.000			513.591		
150.000			655.193		
200.000			857.296		
250.000			1111.388		
300.000			1408.956		
350.000			1741.484		
400.000			2100.461		
450.000			2477.373		
500.000			2863.706		
550.000			3250.946		
600.000			3630.581		
650.000			3994.098		
700.000			4332.981		
750.000			4638.719		
800.000			4902.797		
850.000			5116.702		
900.000			5271.921		
950.000			5359.941		
1000.000			5372.247		

CODE NAME POLYNOMIAL CURVE FIT
MJ PIPE 2-8

ORDER	OBSERVATIONS
3	9

0	4.459480E+02
1	-9.308991E-01
2	1.720846E-02
3	-1.135126E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
125.000	364.000	1.000	257.022	106.978	1.416
240.000	538.000	1.000	571.616	-33.616	.941
80.000	87.000	1.000	155.023	-68.023	.561
400.000	1148.000	1.000	1138.271	9.729	1.009
270.000	650.000	1.000	666.433	-16.433	.975
500.000	1570.000	1.000	1568.634	1.366	1.001
50.000			93.618		
100.000			198.891		
150.000			318.818		
200.000			453.399		
250.000			602.636		
300.000			766.526		
350.000			945.072		
400.000			1138.271		
450.000			1346.125		
500.000			1568.634		
550.000			1805.797		
600.000			2057.615		

CODE NAME POLYNOMIAL CURVE FIT
CU PIPE 2MAX

ORDER	OBSERVATIONS
2	6

0	2.999596E+00
1	1.665820E+00
2	2.930898E-03

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
860.000	2883.000	1.000	2894.177	-11.177	.996
20.000	762.000	1.000	889.046	-127.046	.857
40.000	993.000	1.000	906.925	86.075	1.095
2000.000	7198.000	1.000	7200.273	-2.273	1.000
1400.000	4971.000	1.000	4961.628	9.372	1.002
300.000	1278.000	1.000	1295.179	-17.179	.987
85.000	1016.000	1.000	953.772	62.228	1.065
100.000			971.384		
200.000			1113.246		
300.000			1295.179		
400.000			1513.758		
500.000			1765.558		
600.000			2047.155		
700.000			2355.123		
800.000			2686.038		
900.000			3036.475		
1000.000			3403.010		
1100.000			3782.217		
1200.000			4170.672		
1300.000			4564.951		
1400.000			4961.628		
1500.000			5357.279		
1600.000			5748.478		
1700.000			6131.803		
1800.000			6503.826		
1900.000			6861.125		
2000.000			7200.273		

CODE NAME POLYNOMIAL CURVE FIT
PVC PIPE 4-8

ORDER	OBSERVATIONS
3	7

0	8.730165E+02
1	7.547796E-01
2	2.346003E-03
3	-5.707991E-07

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
714.000	1235.000	1.000	1449.228	-214.228	.852
1825.000	3816.000	1.000	3810.997	5.003	1.001
220.000	450.000	1.000	493.844	-43.844	.911
160.000	371.000	1.000	381.778	-10.778	.972
100.000	213.000	1.000	270.573	-57.573	.787
105.000	356.000	1.000	279.807	76.193	1.272
500.000	970.000	1.000	1028.196	-58.196	.943
600.000	1527.000	1.000	1223.577	303.423	1.248
100.000			270.573		
200.000			456.393		
300.000			644.603		
400.000			835.204		
500.000			1028.196		
600.000			1223.577		
700.000			1421.350		
800.000			1621.512		
900.000			1824.065		
1000.000			2029.008		
1100.000			2236.342		
1200.000			2446.066		
1300.000			2658.180		
1400.000			2872.684		
1500.000			3089.580		
1600.000			3308.865		
1700.000			3530.541		
1800.000			3754.607		
1900.000			3981.063		
2000.000			4209.910		

CODE NAME POLYNOMIAL CURVE FIT
FE PIPE TMAX

ORDER OBSERVATIONS
2 8

0	8.714285E+01
1	1.822347E+00
2	1.195186E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
220.000	1116.000	1.000	1240.982	-124.982	.899
520.000	2310.000	1.000	2338.902	-28.902	.988
200.000	1606.000	1.000	1133.358	472.642	1.417
240.000	1186.000	1.000	1341.473	-155.473	.884
500.000	2584.000	1.000	2274.606	309.394	1.136
840.000	4161.000	1.000	4047.023	113.977	1.028
40.000	58.000	1.000	-57.239	115.239	-1.013
180.000	1016.000	1.000	1017.993	-1.993	.998
126.000	509.000	1.000	663.098	-154.098	.768
450.000	2799.000	1.000	2118.478	680.522	1.321
100.000	349.000	1.000	466.999	-117.999	.747
200.000	473.000	1.000	1133.358	-660.358	.417
80.000	534.000	1.000	303.834	230.166	1.758
200.000	1193.000	1.000	1133.358	59.642	1.053
600.000	1884.000	1.000	2621.779	-737.779	.719
50.000			37.562		
100.000			466.999		
150.000			829.105		
200.000			1133.358		
250.000			1389.233		
300.000			1606.206		
350.000			1793.753		
400.000			1961.352		
450.000			2118.478		
500.000			2274.606		
550.000			2439.215		
600.000			2621.779		
650.000			2831.775		
700.000			3078.679		
750.000			3371.967		
800.000			3721.116		
850.000			4135.602		

CODE NAME POLYNOMIAL CURVE FIT
FE PIPE 4MAX

ORDER	OBSERVATIONS
3	15

0	-4.686819E+02
1	1.095611E+01
2	-1.725655E-02
3	1.263496E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
20.000	4578.000	1.000	4944.077	-366.077	.926
10.000	2632.000	1.000	2730.588	-98.588	.964
5.000	1618.000	1.000	1260.756	357.244	1.283
15.000	3644.000	1.000	3952.021	-308.021	.922
50.000	7159.000	1.000	7144.804	14.196	1.002
3.000	452.000	1.000	599.010	-147.010	.755
12.000	3670.000	1.000	3247.904	422.096	1.130
20.000	5565.000	1.000	4944.077	620.923	1.126
30.000	6265.000	1.000	6316.154	-51.154	.992
10.000	2280.000	1.000	2730.588	-450.588	.835
15.000	3986.000	1.000	3952.021	33.979	1.009
40.000	6972.000	1.000	6999.002	-27.002	.996
3.000			599.010		
6.000			1575.507		
9.000			2457.102		
12.000			3247.904		
15.000			3952.021		
18.000			4573.562		
21.000			5116.637		
24.000			5585.355		
27.000			5983.824		
30.000			6316.154		
33.000			6586.453		
36.000			6798.830		
39.000			6957.395		
42.000			7066.256		
45.000			7129.522		
48.000			7151.302		
51.000			7135.706		

CODE NAME POLYNOMIAL CURVE FIT
A/C EQUIPMNT

ORDER	OBSERVATIONS
3	12

0	-4.764986E+02
1	3.754613E+02
2	-5.728904E+00
3	2.534399E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
2150.000	3917.000	1.000	3294.644	622.356	1.189
5200.000	5628.000	1.000	4926.851	701.149	1.142
4473.000	4009.000	1.000	4457.793	-448.793	.899
2500.000	3315.000	1.000	3437.179	-122.179	.964
5600.000	4866.000	1.000	5206.286	-340.286	.935
1857.000	2772.000	1.000	3184.247	-412.247	.871
500.000			2779.025		
1000.000			2908.034		
1500.000			3060.729		
2000.000			3237.111		
2500.000			3437.179		
3000.000			3660.934		
3500.000			3908.375		
4000.000			4179.503		
4500.000			4474.318		
5000.000			4792.818		
5500.000			5135.006		
6000.000			5500.879		

CODE NAME POLYNOMIAL CURVE FIT

INS DUCTWORK

ORDER	OBSERVATIONS
2	6

0	2.673702E+03
1	1.869583E-01
2	4.737298E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
22.000	1029.000	1.000	890.768	138.232	1.155
60.000	1725.000	1.000	1782.062	-57.062	.968
78.000	2325.000	1.000	2288.636	36.364	1.016
18.000	697.000	1.000	811.012	-114.012	.859
114.000	3461.000	1.000	3464.523	-3.523	.999
5.000			570.303		
10.000			659.535		
15.000			752.952		
20.000			850.555		
25.000			952.344		
30.000			1058.318		
35.000			1168.478		
40.000			1282.823		
45.000			1401.354		
50.000			1524.071		
55.000			1650.973		
60.000			1782.062		
65.000			1917.335		
70.000			2056.795		
75.000			2200.440		
80.000			2348.271		
85.000			2500.287		
90.000			2656.489		
95.000			2816.877		
100.000			2981.450		
105.000			3150.209		
110.000			3323.153		
115.000			3500.284		
120.000			3681.600		

CODE NAME POLYNOMIAL CURVE FIT

AIR REGISTER

ORDER	OBSERVATIONS
2	5

0	4.852573E+02
1	1.659062E+01
2	8.371302E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
60.000	5414.000	1.000	5481.418	-67.418	.988
40.000	4639.000	1.000	4672.709	-33.709	.993
50.000	5115.000	1.000	5025.109	89.891	1.018
80.000	6717.000	1.000	6705.764	11.236	1.002
10.000			4238.964		
20.000			4279.636		
30.000			4424.218		
40.000			4672.709		
50.000			5025.109		
60.000			5481.418		
70.000			6041.636		
80.000			6705.764		
90.000			7473.800		
100.000			8345.745		

CODE NAME POLYNOMIAL CURVE FIT
BOILERS

ORDER	OBSERVATIONS
2	4

0	4.302200E+03
1	-1.151909E+01
2	5.195455E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
100000.000	175.000	1.000	187.797	-12.797	.932
25000.000	137.000	1.000	133.973	3.027	1.023
180000.000	333.000	1.000	321.622	11.378	1.035
120000.000	232.000	1.000	213.859	18.141	1.085
75000.000	158.000	1.000	162.153	-4.153	.974
150000.000	254.000	1.000	262.194	-8.194	.969
200000.000	360.000	1.000	367.402	-7.402	.980
20000.000			132.850		
40000.000			139.192		
60000.000			150.464		
80000.000			166.606		
100000.000			187.797		
120000.000			213.859		
140000.000			244.850		
160000.000			280.771		
180000.000			321.622		
200000.000			367.402		

CODE NAME POLYNOMIAL CURVE FIT
FURNACES

ORDER	OBSERVATIONS
2	7

0	1.314378E+02
1	-5.263395E-05
2	6.152282E-09

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
3.000	466.000	1.000	466.885	-.885	.998
.250	224.000	1.000	229.944	-5.944	.974
1.000	353.000	1.000	352.729	.271	1.001
2.000	382.000	1.000	388.004	-6.004	.985
.500	296.000	1.000	286.537	9.463	1.033
1.500	368.000	1.000	377.897	-9.897	.974
2.000	401.000	1.000	388.004	12.996	1.033
.250			229.944		
.500			286.537		
.750			326.383		
1.000			352.729		
1.250			368.818		
1.500			377.897		
1.750			383.211		
2.000			388.004		
2.250			395.523		
2.500			409.013		
2.750			431.718		
3.000			466.885		

CODE NAME POLYNOMIAL CURVE FIT
EXHAUST FANS

ORDER	OBSERVATIONS
3	7

0	1.533594E+02
1	3.506496E+02
2	-1.858968E+02
3	3.461658E+01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1100.000	462.000	1.000	653.694	-191.694	.707
3090.000	1284.000	1.000	1151.211	132.789	1.115
5000.000	1618.000	1.000	1598.409	19.591	1.012
20000.000	4199.000	1.000	4078.054	120.946	1.030
200.000	273.000	1.000	418.099	-145.099	.653
15000.000	3227.000	1.000	3455.012	-228.012	.934
4000.000	1653.000	1.000	1367.978	285.022	1.208
6500.000	1836.000	1.000	1928.794	-92.794	.952
1500.000	850.000	1.000	756.286	93.714	1.124
10000.000	2634.000	1.000	2628.463	5.537	1.002
1000.000			627.842		
2000.000			882.694		
3000.000			1129.406		
4000.000			1367.978		
5000.000			1598.409		
6000.000			1820.701		
7000.000			2034.852		
8000.000			2240.862		
9000.000			2438.733		
10000.000			2628.463		
11000.000			2810.053		
12000.000			2983.503		
13000.000			3148.813		
14000.000			3305.982		
15000.000			3455.012		
16000.000			3595.901		
17000.000			3728.649		
18000.000			3853.258		
19000.000			3969.726		
20000.000			4078.054		

CODE NAME   POLYNOMIAL CURVE FIT
WIRE 6-2/0

ORDER	OBSERVATIONS
2	10

0	3.646498E+02
1	2.670625E-01
2	-4.070114E-06

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
7600.000	6719.000	1.000	6657.196	61.804	1.009
700.000	1731.000	1.000	1613.916	117.084	1.073
6200.000	4996.000	1.000	5419.772	-423.772	.922
1500.000	2193.000	1.000	2062.923	130.077	1.063
9500.000	8633.000	1.000	8510.936	122.064	1.014
5000.000	4381.000	1.000	4445.896	-64.896	.985
2200.000	2084.000	1.000	2485.007	-401.007	.839
2600.000	3227.000	1.000	2738.435	488.565	1.178
50.000	965.000	1.000	1275.310	-310.310	.757
2400.000	2891.000	1.000	2610.608	280.392	1.107
500.000			1507.226		
1000.000			1778.122		
1500.000			2062.923		
2000.000			2361.631		
2500.000			2674.244		
3000.000			3000.762		
3500.000			3341.187		
4000.000			3695.517		
4500.000			4063.754		
5000.000			4445.896		
5500.000			4841.944		
6000.000			5251.897		
6500.000			5675.757		
7000.000			6113.522		
7500.000			6565.193		
8000.000			7030.770		
8500.000			7510.253		
9000.000			8003.642		
9500.000			8510.936		
10000.000			9032.136		

CODE NAME POLYNOMIAL CURVE FIT
WRE 3/0-600M

ORDER OBSERVATIONS
2 10

0 1.250237E+03
1 5.000737E-01
2 2.781163E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1000.000	106.000	1.000	154.073	-48.073	.688
6420.000	562.000	1.000	534.590	27.410	1.051
2500.000	253.000	1.000	254.738	-1.738	.993
15000.000	1261.000	1.000	1231.838	29.162	1.024
3080.000	352.000	1.000	294.614	57.386	1.195
3400.000	285.000	1.000	316.843	-31.843	.899
1650.000	222.000	1.000	197.258	24.742	1.125
11750.000	897.000	1.000	954.046	-57.046	.940
1000.000			154.073		
2000.000			220.788		
3000.000			289.083		
4000.000			358.957		
5000.000			430.411		
6000.000			503.445		
7000.000			578.059		
8000.000			654.252		
9000.000			732.025		
10000.000			811.376		
11000.000			892.310		
12000.000			974.823		
13000.000			1058.915		
14000.000			1144.586		
15000.000			1231.838		
16000.000			1320.669		
17000.000			1411.080		
18000.000			1503.070		
19000.000			1596.641		
20000.000			1691.791		

CODE NAME POLYNOMIAL CURVE FIT
WIRE NO 14-8

ORDER	OBSERVATIONS
2	8

0	8.893760E+01
1	6.434540E-02
2	7.898626E-07

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
280.000	219.000	1.000	40.961	178.039	5.347
6000.000	3826.000	1.000	4995.834	-1169.834	.766
150.000	300.000	1.000	-71.649	371.649	-4.187
40.000	101.000	1.000	-166.935	267.935	-.605
600.000	299.000	1.000	318.157	-19.157	.940
1830.000	1182.000	1.000	1383.628	-201.628	.854
5000.000	2832.000	1.000	4129.597	-1297.597	.686
1000.000	579.000	1.000	664.652	-85.652	.871
325.000	266.000	1.000	79.942	186.058	3.327
4000.000	2561.000	1.000	3263.361	-702.361	.785
2500.000	1728.000	1.000	1964.006	-236.006	.880
6040.000	8697.000	1.000	5030.483	3666.517	1.729
200.000	219.000	1.000	-28.338	247.338	-7.728
1350.000	823.000	1.000	967.834	-144.834	.850
4530.000	2662.000	1.000	3722.466	-1060.466	.715
500.000			231.533		
1000.000			664.652		
1500.000			1097.770		
2000.000			1530.888		
2500.000			1964.006		
3000.000			2397.125		
3500.000			2830.243		
4000.000			3263.361		
4500.000			3696.479		
5000.000			4129.597		
5500.000			4562.716		
6000.000			4995.834		

CODE NAME POLYNOMIAL CURVE FIT
CONDUIT QMAX

ORDER	OBSERVATIONS
1	15

0	-2.015848E+02
1	8.662354E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1250.000	2498.000	1.000	2652.728	-154.728	.942
1800.000	2810.000	1.000	3282.709	-472.709	.856
430.000	987.000	1.000	1294.120	-307.120	.763
500.000	2203.000	1.000	1429.697	773.303	1.541
100.000	570.000	1.000	605.697	-35.697	.941
1800.000	3811.000	1.000	3282.709	528.291	1.161
360.000	938.000	1.000	1154.885	-216.885	.812
520.000	1279.000	1.000	1467.761	-188.761	.871
250.000	1003.000	1.000	928.695	74.305	1.080
100.000			605.697		
200.000			822.896		
300.000			1032.629		
400.000			1234.896		
500.000			1429.697		
600.000			1617.032		
700.000			1796.901		
800.000			1969.304		
900.000			2134.241		
1000.000			2291.713		
1100.000			2441.718		
1200.000			2584.258		
1300.000			2719.331		
1400.000			2846.939		
1500.000			2967.080		
1600.000			3079.756		
1700.000			3184.965		
1800.000			3282.709		
1900.000			3372.987		
2000.000			3455.799		

CODE NAME POLYNOMIAL CURVE FIT
CONDUIT 4MAX

ORDER	OBSERVATIONS
2	9

0	3.810318E+02
1	2.283979E+00
2	-3.732975E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
4.000	127.000	1.000	198.695	-71.695	.639
20.000	766.000	1.000	810.507	-44.507	.945
24.000	919.000	1.000	964.333	-45.333	.953
44.000	2019.000	1.000	1738.703	280.297	1.161
110.000	4201.000	1.000	4356.082	-155.082	.964
160.000	6416.000	1.000	6402.254	13.746	1.002
34.000	1458.000	1.000	1350.426	107.574	1.080
60.000	2482.000	1.000	2364.487	117.513	1.050
6.000	208.000	1.000	274.866	-66.866	.757
145.000	5837.000	1.000	5782.672	54.328	1.009
10.000	640.000	1.000	427.469	212.531	1.497
83.000	3000.000	1.000	3273.842	-273.842	.916
120.000	4848.000	1.000	4760.950	87.050	1.018
15.000	403.000	1.000	618.715	-215.715	.651
10.000			427.469		
20.000			810.507		
30.000			1195.727		
40.000			1583.131		
50.000			1972.717		
60.000			2364.487		
70.000			2758.440		
80.000			3154.575		
90.000			3552.894		
100.000			3953.396		
110.000			4356.082		
120.000			4760.950		
130.000			5168.001		
140.000			5577.236		
150.000			5988.653		
160.000			6402.254		

CODE NAME   POLYNOMIAL CURVE FIT
LT FIXTURES

ORDER	OBSERVATIONS
2	14

0	4.661518E+01
1	3.797627E+01
2	1.091548E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
20.000	139.000	1.000	102.275	36.725	1.359
72.000	532.000	1.000	611.415	-79.415	.870
50.000	368.000	1.000	329.959	38.041	1.115
8.000	55.000	1.000	84.374	-29.374	.652
158.000	1734.000	1.000	1737.819	-3.819	.998
132.000	1472.000	1.000	1483.038	-11.038	.993
110.000	1230.000	1.000	1181.120	48.880	1.041
10.000			83.890		
20.000			102.275		
30.000			152.234		
40.000			229.538		
50.000			329.959		
60.000			449.267		
70.000			583.234		
80.000			727.632		
90.000			878.231		
100.000			1030.804		
110.000			1181.120		
120.000			1324.953		
130.000			1458.072		
140.000			1576.250		
150.000			1675.257		
160.000			1750.866		

CODE NAME POLYNOMIAL CURVE FIT
RECEP/SWITCH

ORDER	OBSERVATIONS
3	7

0	1.013070E+02
1	-3.672793E+00
2	2.001555E-01
3	-7.047793E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
20.000	327.000	1.000	339.199	-12.199	.964
16.000	303.000	1.000	281.502	21.498	1.076
28.000	424.000	1.000	485.050	-61.050	.874
36.000	734.000	1.000	652.960	81.040	1.124
30.000	479.000	1.000	525.829	-46.829	.911
24.000	444.000	1.000	407.976	36.024	1.088
8.000	202.000	1.000	210.477	-8.477	.960
30.000	533.000	1.000	525.829	7.171	1.014
20.000	348.000	1.000	339.199	8.801	1.026
42.000	754.000	1.000	779.977	-25.977	.967
2.000			206.988		
4.000			202.714		
6.000			203.994		
8.000			210.477		
10.000			221.818		
12.000			237.668		
14.000			257.678		
16.000			281.502		
18.000			308.792		
20.000			339.199		
22.000			372.377		
24.000			407.976		
26.000			445.650		
28.000			485.050		
30.000			525.829		
32.000			567.639		
34.000			610.132		
36.000			652.960		
38.000			695.775		
40.000			738.230		
42.000			779.977		

CODE NAME POLYNOMIAL CURVE FIT
DIST PANELS

ORDER	OBSERVATIONS
3	10

0	2.171610E+02
1	-6.619748E+00
2	7.810053E-01
3	-7.246083E-03

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
45.000	1101.000	1.000	1085.345	15.655	1.014
100.000	1682.000	1.000	1710.805	-28.805	.983
30.000	693.000	1.000	809.429	-116.429	.856
75.000	1563.000	1.000	1501.744	61.256	1.041
15.000	565.000	1.000	488.370	76.630	1.157
9.000	339.000	1.000	347.307	-8.307	.976
5.000			249.251		
10.000			371.319		
15.000			488.370		
20.000			600.406		
25.000			707.426		
30.000			809.429		
35.000			906.417		
40.000			998.389		
45.000			1085.345		
50.000			1167.284		
55.000			1244.208		
60.000			1316.116		
65.000			1383.008		
70.000			1444.884		
75.000			1501.744		
80.000			1553.588		
85.000			1600.416		
90.000			1642.228		
95.000			1679.025		
100.000			1710.805		

CODE NAME POLYNOMIAL CURVE FIT
TRANSFORMERS

ORDER	OBSERVATIONS
2	6

0	1.221680E+02
1	2.591829E+01
2	-1.003192E-01

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
432.000	13622.000	1.000	14186.594	-564.594	.960
190.000	8853.000	1.000	9364.321	-511.321	.945
110.000	4806.000	1.000	5366.506	-560.506	.896
362.000	14879.000	1.000	13915.178	963.822	1.069
80.000	4232.000	1.000	3559.401	672.599	1.189
25.000			-189.850		
50.000			1584.338		
75.000			3241.887		
100.000			4782.799		
125.000			6207.074		
150.000			7514.710		
175.000			8705.708		
200.000			9780.068		
225.000			10737.790		
250.000			11578.875		
275.000			12303.321		
300.000			12911.130		
325.000			13402.300		
350.000			13776.833		
375.000			14034.727		
400.000			14175.984		
425.000			14200.603		
450.000			14108.584		
475.000			13899.926		
500.000			13574.631		

CODE NAME POLYNOMIAL CURVE FIT
FIRE PROTECT

ORDER	OBSERVATIONS
2	5

0	-2.080676E+03
1	7.796579E+01
2	-9.331035E-02

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
3655.000	9501.000	1.000	9879.850	-378.850	.962
673.000	2648.000	1.000	2248.193	399.807	1.178
903.000	3155.000	1.000	2692.135	462.865	1.172
1314.000	3947.000	1.000	3545.660	401.340	1.113
2778.000	6992.000	1.000	7213.413	-221.413	.969
120.000	598.000	1.000	1279.778	-681.778	.467
3800.000	11161.000	1.000	10354.582	806.418	1.078
3000.000	8576.000	1.000	7855.145	720.855	1.092
2900.000	6082.000	1.000	7563.288	-1481.288	.804
2290.000	5854.000	1.000	5881.957	-27.957	.995
250.000			1494.864		
500.000			1930.208		
750.000			2394.124		
1000.000			2886.613		
1250.000			3407.675		
1500.000			3957.309		
1750.000			4535.516		
2000.000			5142.297		
2250.000			5777.649		
2500.000			6441.575		
2750.000			7134.074		
3000.000			7855.145		
3250.000			8604.789		
3500.000			9383.006		
3750.000			10189.796		
4000.000			11025.158		

CODE NAME POLYNOMIAL CURVE FIT
ASPH PAVING

ORDER	OBSERVATIONS
2	10

0	1.088094E+03
1	1.569937E+00
2	2.285824E-04

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1685.000	5019.000	1.000	4762.038	256.962	1.054
526.000	1469.000	1.000	1483.826	-14.826	.990
2008.000	5683.000	1.000	5675.638	7.362	1.001
1640.000	3935.000	1.000	4634.756	-699.756	.849
570.000	1368.000	1.000	1608.279	-240.279	.851
800.000	2346.000	1.000	2258.631	87.169	1.039
410.000	1088.000	1.000	1155.722	-67.722	.941
1196.000	4050.000	1.000	3378.910	671.090	1.199
200.000			561.741		
400.000			1127.437		
600.000			1693.134		
800.000			2258.831		
1000.000			2824.527		
1200.000			3390.224		
1400.000			3955.920		
1600.000			4521.617		
1800.000			5087.313		
2000.000			5653.010		
2200.000			6218.707		
2400.000			6784.403		
2600.000			7350.100		
2800.000			7915.796		
3000.000			8481.493		
3200.000			9047.189		
3400.000			9612.886		
3600.000			10178.582		
3800.000			10744.279		
4000.000			11309.976		
4200.000			11875.672		
4400.000			12441.369		
4600.000			13007.065		
4800.000			13572.762		

CODE NAME POLYNOMIAL CURVE FIT
CURB+GUTTER

ORDER	OBSERVATIONS
1	8

0	-3.955725E+00
1	2.828483E+00

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1425.000	1439.000	1.000	1405.179	33.821	1.024
2495.000	1847.000	1.000	1841.663	5.337	1.003
640.000	635.000	1.000	701.779	-66.779	.905
400.000	387.000	1.000	355.275	31.725	1.089
1800.000	1555.000	1.000	1587.594	-32.594	.979
955.000	1081.000	1.000	1052.509	28.491	1.027
200.000			5.543		
400.000			355.275		
600.000			649.158		
800.000			893.404		
1000.000			1094.229		
1200.000			1257.847		
1400.000			1390.471		
1600.000			1498.315		
1800.000			1587.594		
2000.000			1664.522		
2200.000			1735.312		
2400.000			1806.179		
2600.000			1883.336		
2800.000			1972.998		
3000.000			2081.379		
3200.000			2214.692		
3400.000			2379.153		
3600.000			2580.974		
3800.000			2826.369		
4000.000			3121.554		
4200.000			3472.741		
4400.000			3886.145		
4600.000			4367.980		
4800.000			4924.460		
5000.000			5561.799		

CODE NAME   POLYNOMIAL CURVE FIT
SIDEWALK

ORDER	OBSERVATIONS
3	6

0	-4.062523E+02
1	2.224494E+00
2	-8.534711E-04
3	1.294589E-07

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1400.000	620.000	1.000	604.212	15.788	1.026
2700.000	720.000	1.000	709.596	10.404	1.015
560.000	604.000	1.000	560.083	43.917	1.078
3900.000	849.000	1.000	846.870	2.130	1.003
890.000	596.000	1.000	575.176	20.824	1.036
2000.000	607.000	1.000	647.252	-40.252	.938
400.000	501.000	1.000	553.811	-52.811	.905
250.000			548.550		
500.000			557.651		
750.000			568.418		
1000.000			580.852		
1250.000			594.952		
1500.000			610.719		
1750.000			628.152		
2000.000			647.252		
2250.000			668.018		
2500.000			690.451		
2750.000			714.550		
3000.000			740.315		
3250.000			767.747		
3500.000			796.846		
3750.000			827.611		
4000.000			860.042		

CODE NAME POLYNOMIAL CURVE FIT
GRASS SEED

ORDER	OBSERVATIONS
2	7

0	5.411159E+02
1	2.640435E-02
2	1.333180E-05

INDEPEND VAR	DEPEND VAR	WEIGHT	FITTED DEPEND	ARITH DIFFERENCE	RATIO OBSERVED TO FIT
1780.000	5991.000	1.000	6201.572	-210.572	.966
4525.000	11850.000	1.000	11879.973	-29.973	.997
7560.000	13280.000	1.000	13277.007	2.993	1.000
900.000	3422.000	1.000	3340.546	81.454	1.024
2500.000	8317.000	1.000	8149.813	167.187	1.021
312.000	1110.000	1.000	1121.089	-11.089	.990
250.000			872.252		
500.000			1858.218		
750.000			2798.271		
1000.000			3693.088		
1250.000			4543.342		
1500.000			5349.710		
1750.000			6112.865		
2000.000			6833.484		
2250.000			7512.242		
2500.000			8149.813		
2750.000			8746.872		
3000.000			9304.095		
3250.000			9822.157		
3500.000			10301.733		
3750.000			10743.498		
4000.000			11148.127		
4250.000			11516.294		
4500.000			11848.677		
4750.000			12145.948		
5000.000			12408.784		

CODE NAME POLYNOMIAL CURVE FIT
FENCING

ORDER	OBSERVATIONS
3	6

0	-1.603011E+02
1	4.224286E+00
2	-3.780988E-04
3	7.200990E-09

APPENDIX B

PRELIMINARY COST ESTIMATING SYSTEM APPLICATION

This cost estimating system, developed by analyzing completed public works projects from various parts of the country, is intended for use by estimators in providing preliminary cost estimates for future projects. The user need only to furnish estimated quantities of the items indicated in the 12 construction categories, the proposed location of the project and an estimate of the time frame in which construction is to take place.

Using these parameters a reasonably accurate cost estimate can be developed for projects up to $200,000. The categories and their items are so constructed that they include all the subordinate work necessarily included in a major category item. For instance, the three concrete categories include forming, reinforcing steel and finish work. The curves developed represent an expected base cost for the items indicated.

The first step in the use of the system involves the segregation of project elements into each of the applicable construction categories. The estimated

quantity for each item within the category is then applied to the cost function graph for that item. The sum of all the items in each category must then be adjusted by its particular geographical multiplier as delineated in Table 6-6. The resultant is the estimated cost for each category for that geographic location. The final step in the cost estimating process is the adjustment of the sum of the geographically modified category costs for the projected time frame (from Figure 5-2), the inclusion of overhead and profit, (multiplying by 1.25) and the addition of any contingencies.

Contingency factors can vary anywhere from 1% to 6% depending on how well the project scope is defined, how far in the future the project may be and how many levels of review and possible alteration the project must pass through in the approval process. The estimator should have a feel for the amount to be included as a contingency.

Appendix C contains several applications of this system, with further comments on the degree of accuracy achieved in these applications. The remainder of this Appenidx contains the 55 construction category item graphs to be used with this system.

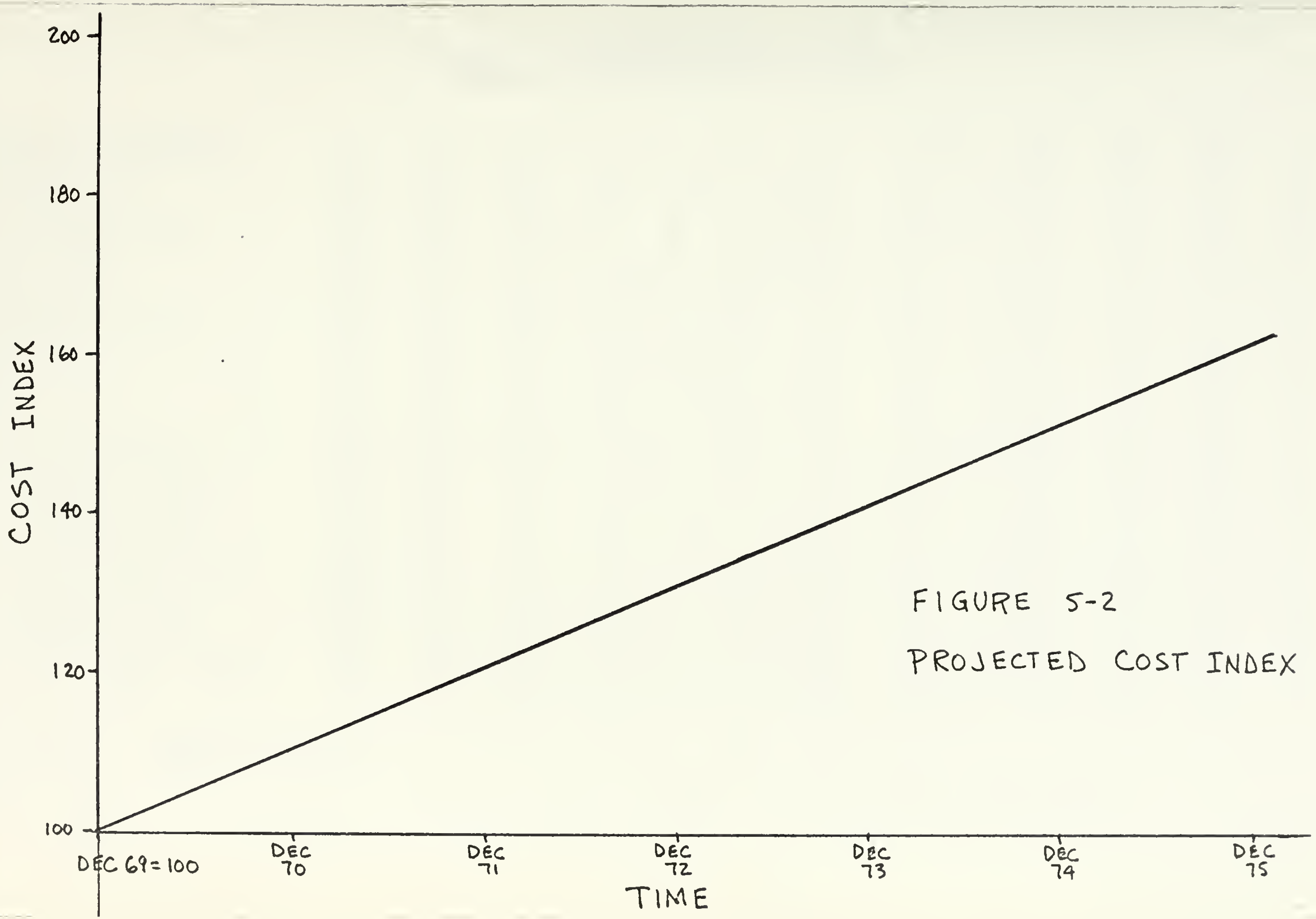


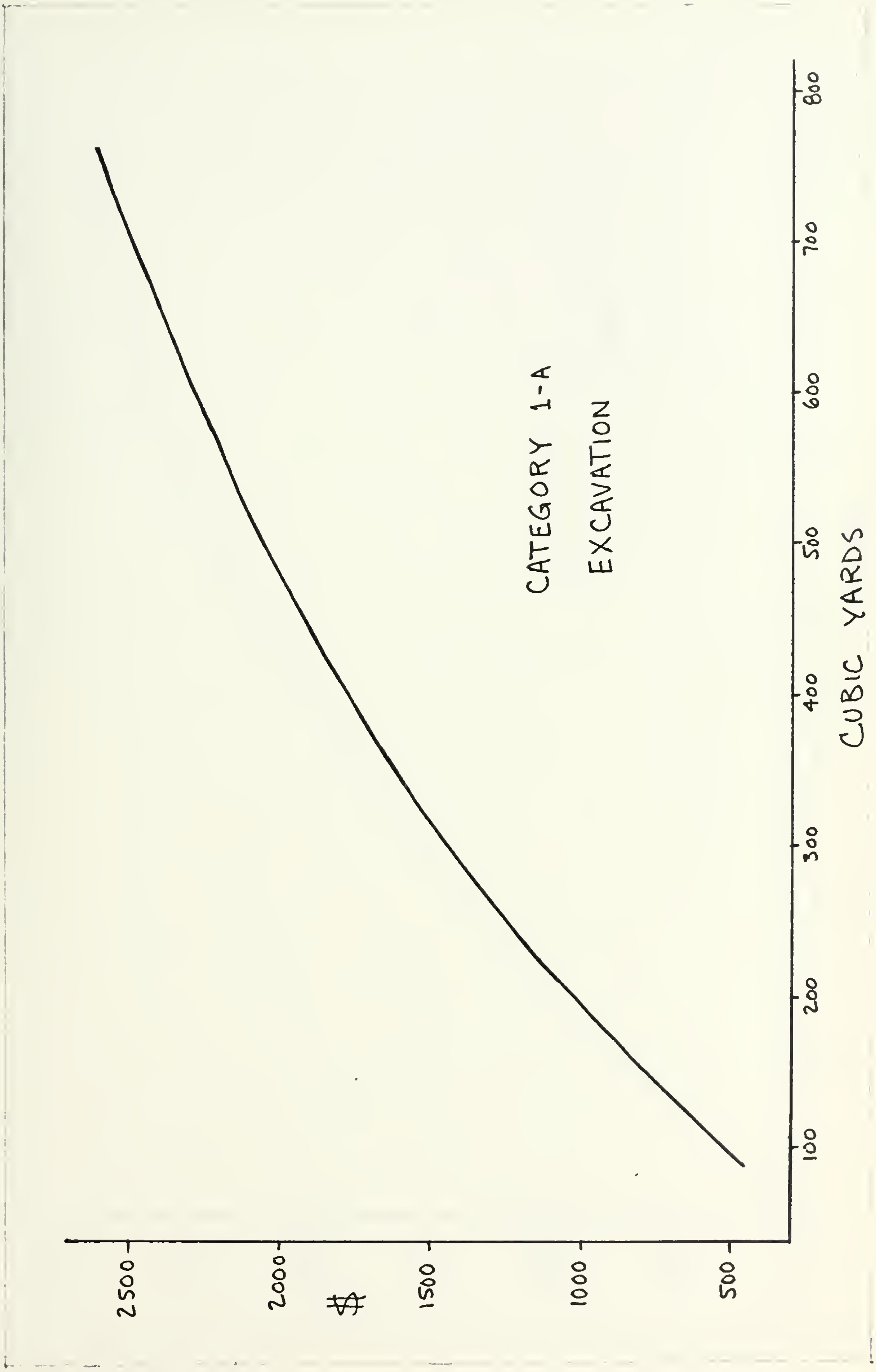
FIGURE 5-2
PROJECTED COST INDEX

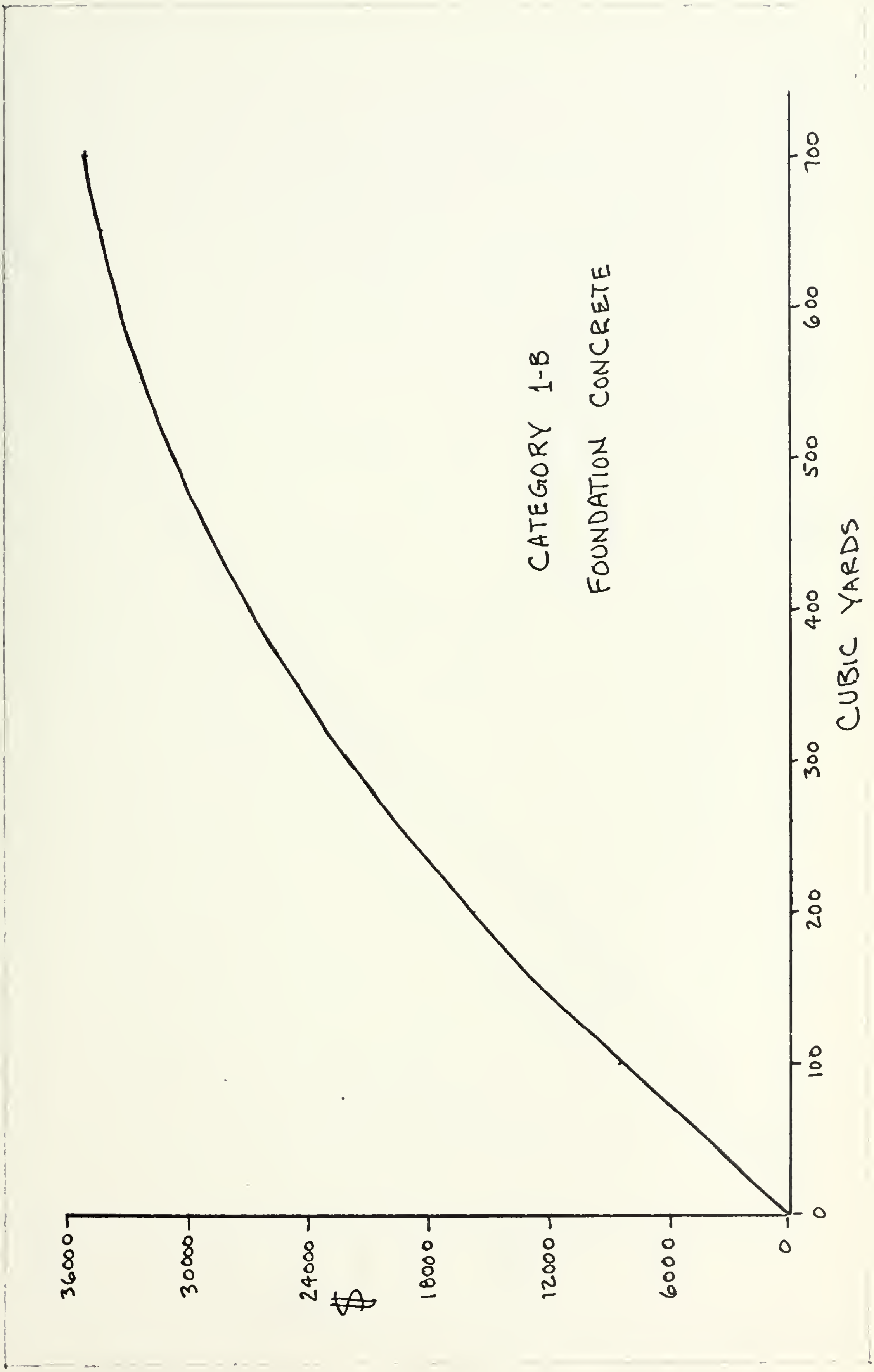
Table 6-6
Table of Combined Multipliers

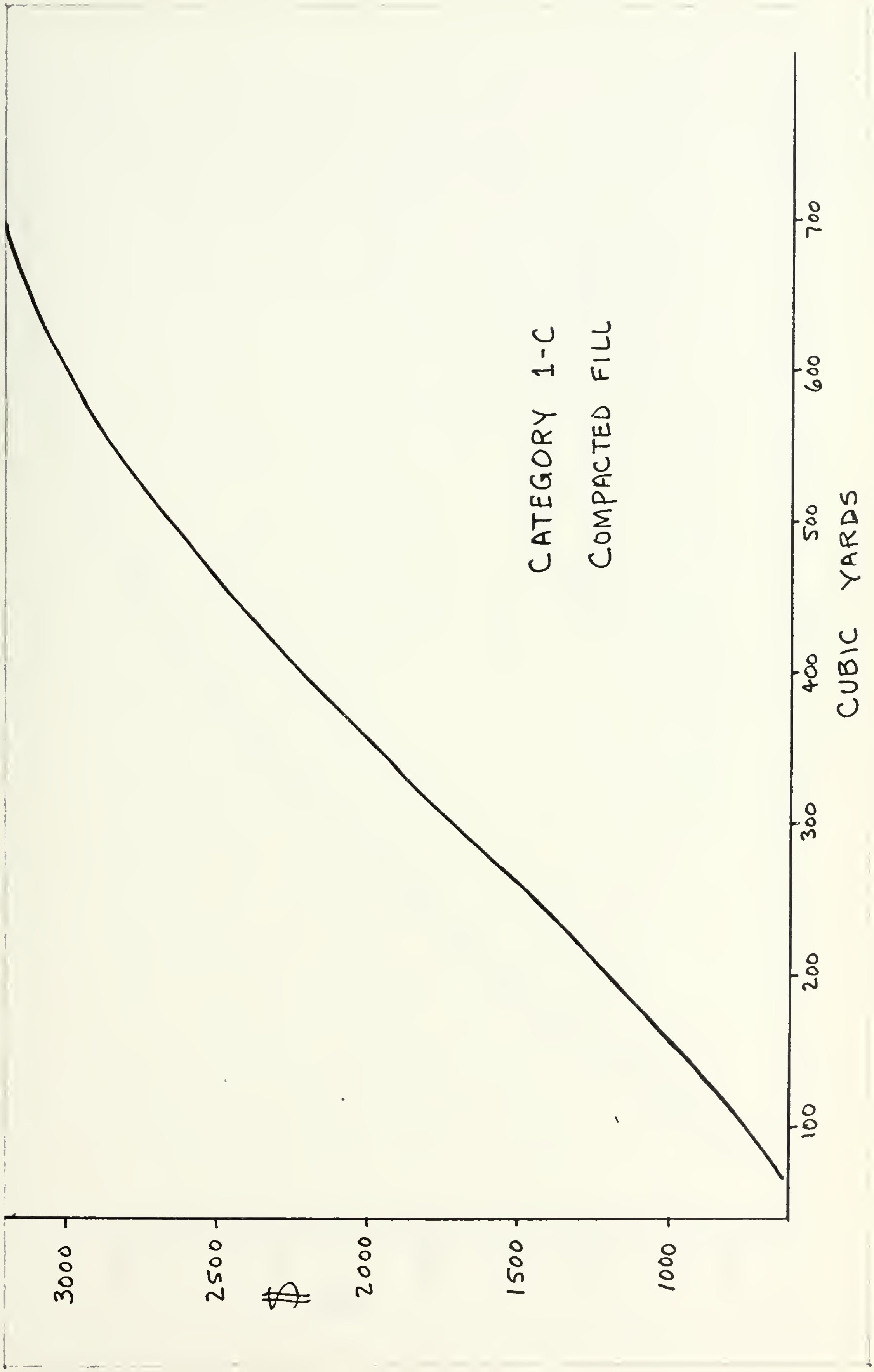
City and City No.	1	2	3	4	5	6	7	8	9	10	11	12	*
Atlanta (1)	80	89	87	85	88	88	105	90	97	98	95	82	91
Baltimore (2)	96	101	105	100	92	97	105	97	113	90	100	100	98
Birmingham (3)	80	87	89	82	87	80	102	102	107	101	93	80	84
Boston (4)	104	106	113	105	102	102	104	103	98	104	103	106	101
Chicago (5)	102	103	101	102	107	109	95	99	97	108	101	104	103
Cincinnati (6)	104	103	98	106	113	107	94	100	97	105	101	111	103
Cleveland (7)	107	106	106	119	111	114	107	119	105	111	107	116	110
Dallas (8)	77	89	83	79	89	85	92	85	90	87	87	83	87
Denver (9)	80	87	91	96	96	96	101	96	96	103	97	86	94
Detroit (10)	111	107	100	104	114	109	91	97	99	102	101	118	111
Kansas City (11)	105	100	109	100	103	100	99	106	100	104	102	99	97
Los Angeles (12)	110	100	99	104	107	105	108	115	119	114	108	103	103
Minneapolis (13)	93	92	89	99	108	98	85	101	96	88	96	95	99
New Orleans (14)	83	87	77	84	83	82	101	106	103	98	93	80	87
New York (15)	124	117	113	116	117	120	106	92	93	104	104	119	118
Philadelphia (16)	101	105	105	100	102	106	112	114	100	112	104	101	104
Pittsburgh (17)	103	103	110	105	109	110	89	91	92	104	102	105	108
St. Louis (18)	108	99	102	104	109	102	85	91	93	87	97	103	98
San Francisco (19)	113	104	103	109	111	111	116	97	108	91	103	107	108
Seattle (20)	95	94	101	100	100	95	116	105	107	105	104	94	90

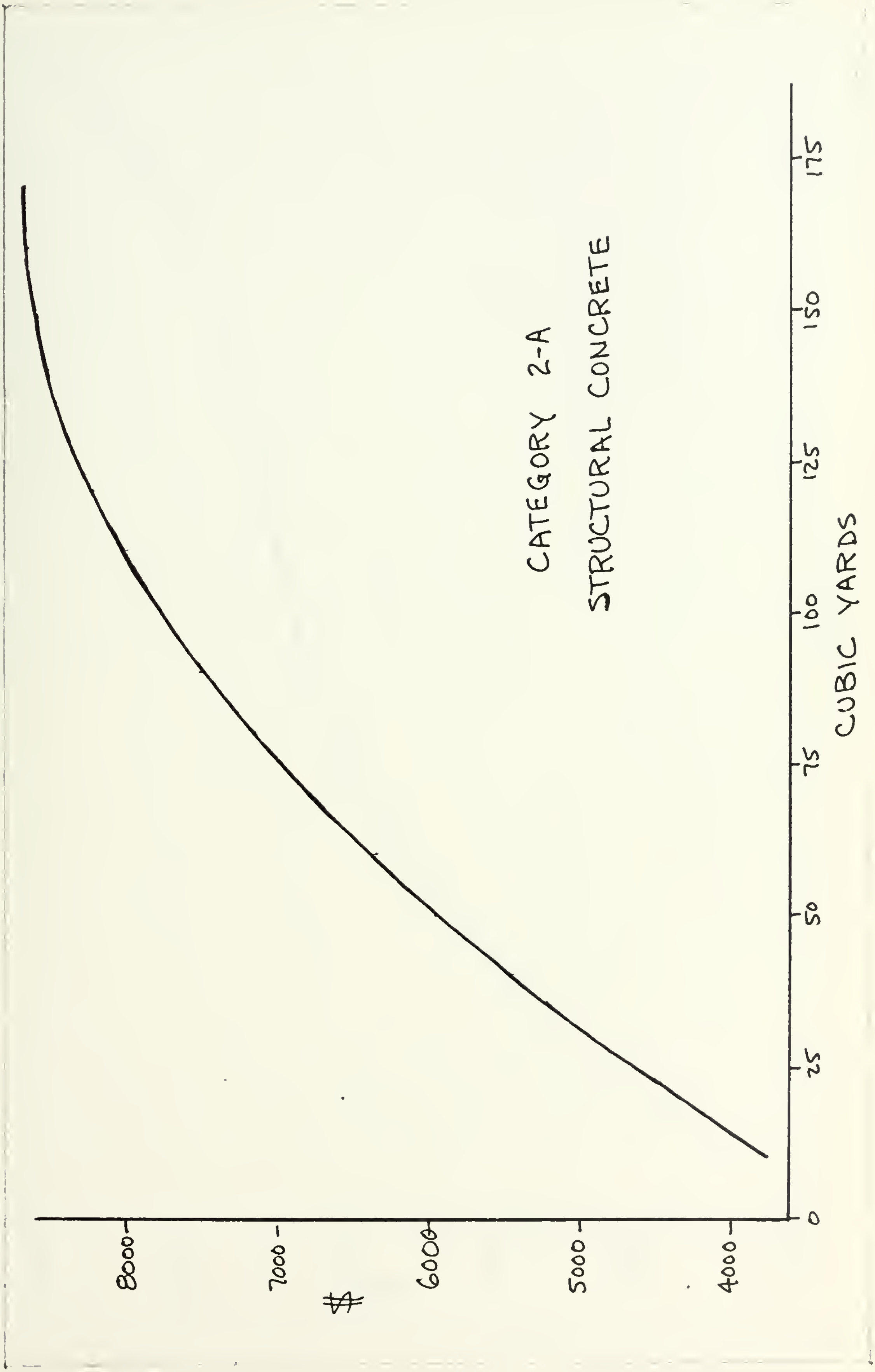
*Original Geographical Index (included in all other multipliers) - to be used for additional, unusual items.

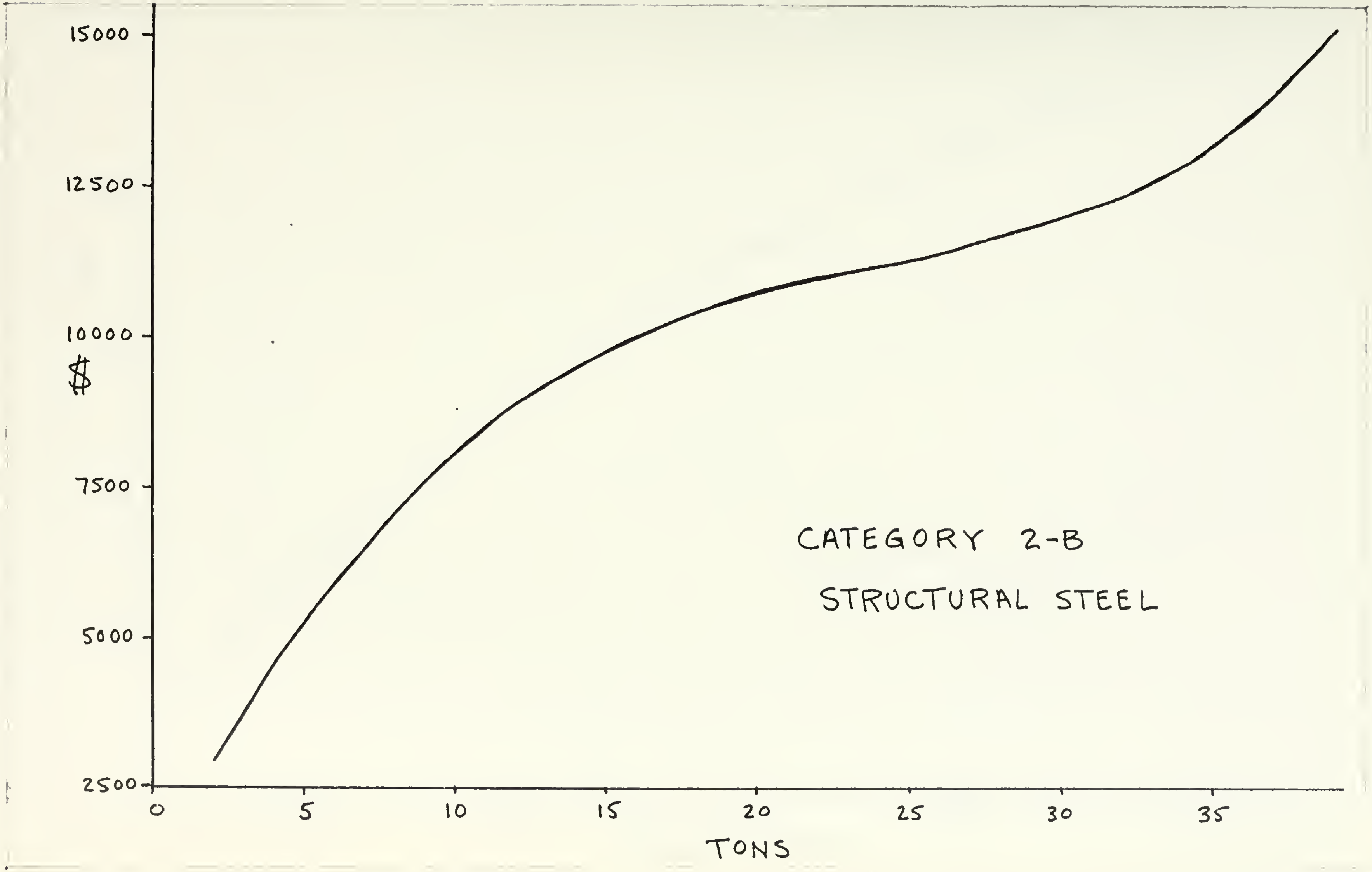
NOTE: Columns 1 through 12 represent the 12 basic construction categories.

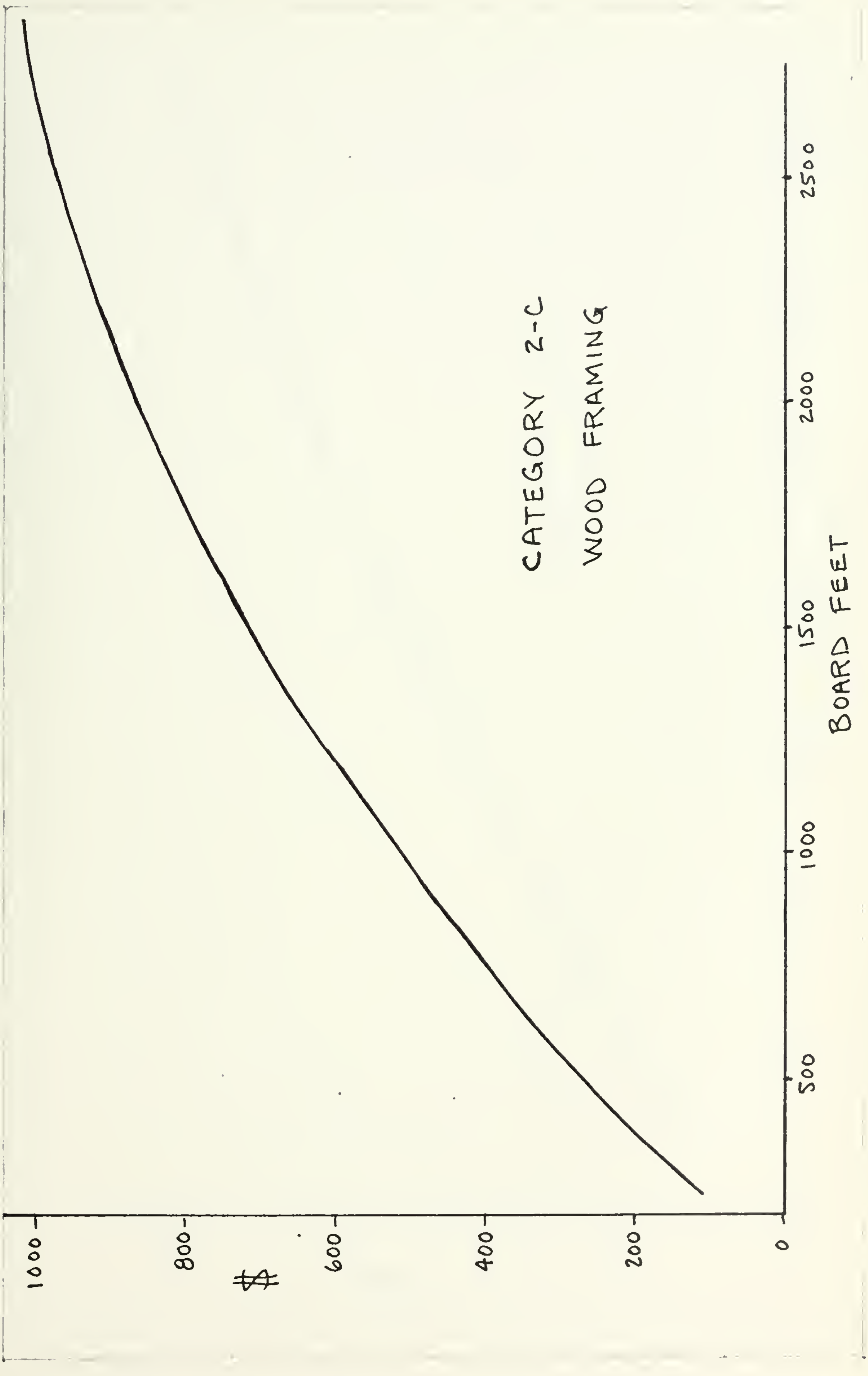

CATEGORY 1-A
EXCAVATION
$
2500
2000
1500
1000
500
100
200
300
400
500
600
700
800
CUBIC YARDS

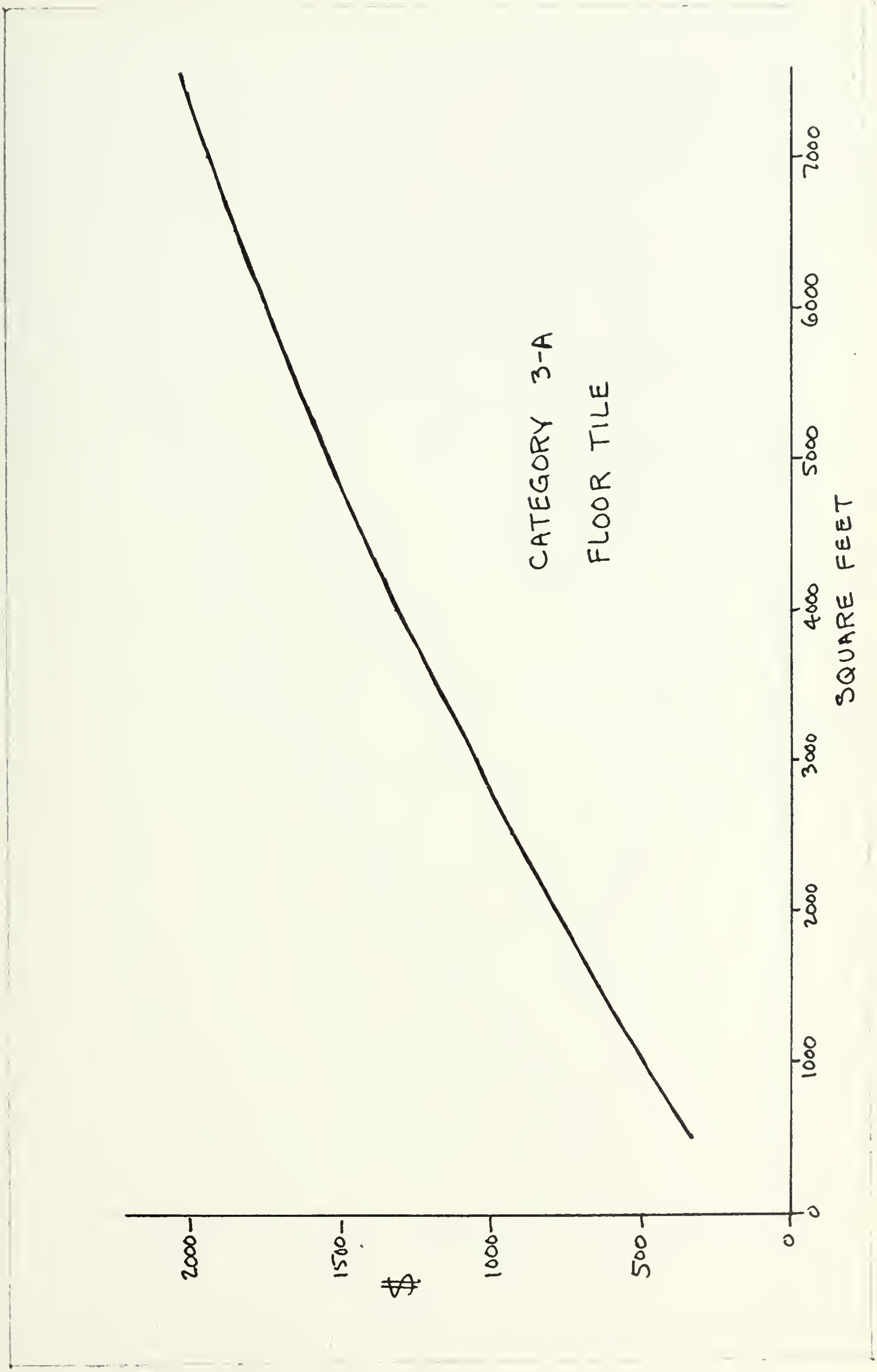

CATEGORY 1-B
FOUNDATION CONCRETE
CUBIC YARDS
$
0
6000
12000
18000
24000
30000
36000
0
100
200
300
400
500
600
700

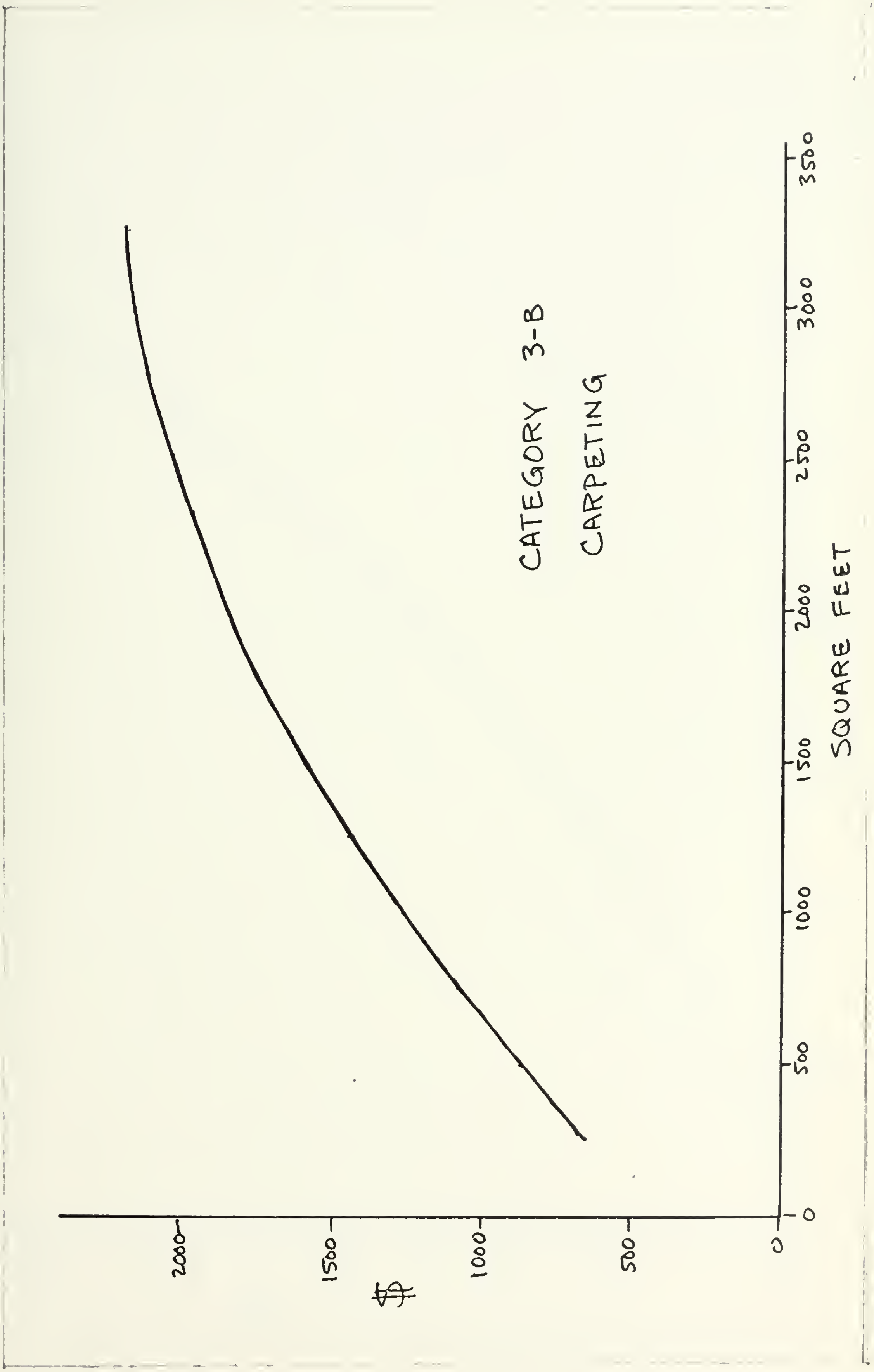

CATEGORY 1-C
COMPACTED FILL
CUBIC YARDS
$
100
200
300
400
500
600
700
1000
1500
2000
2500
3000

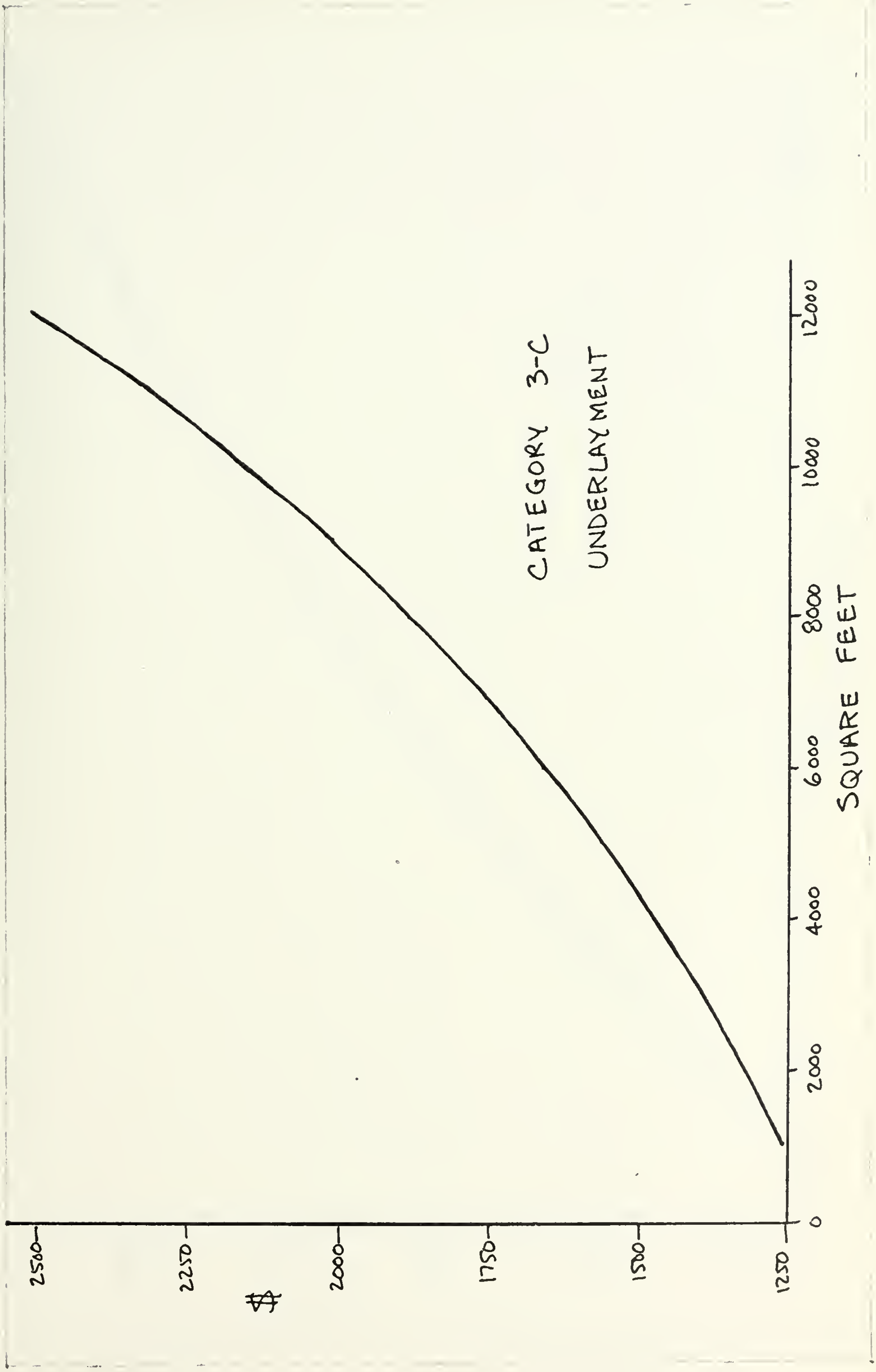

CATEGORY 2-A
STRUCTURAL CONCRETE
CUBIC YARDS
0
25
50
75
100
125
150
175
$
4000
5000
6000
7000
8000

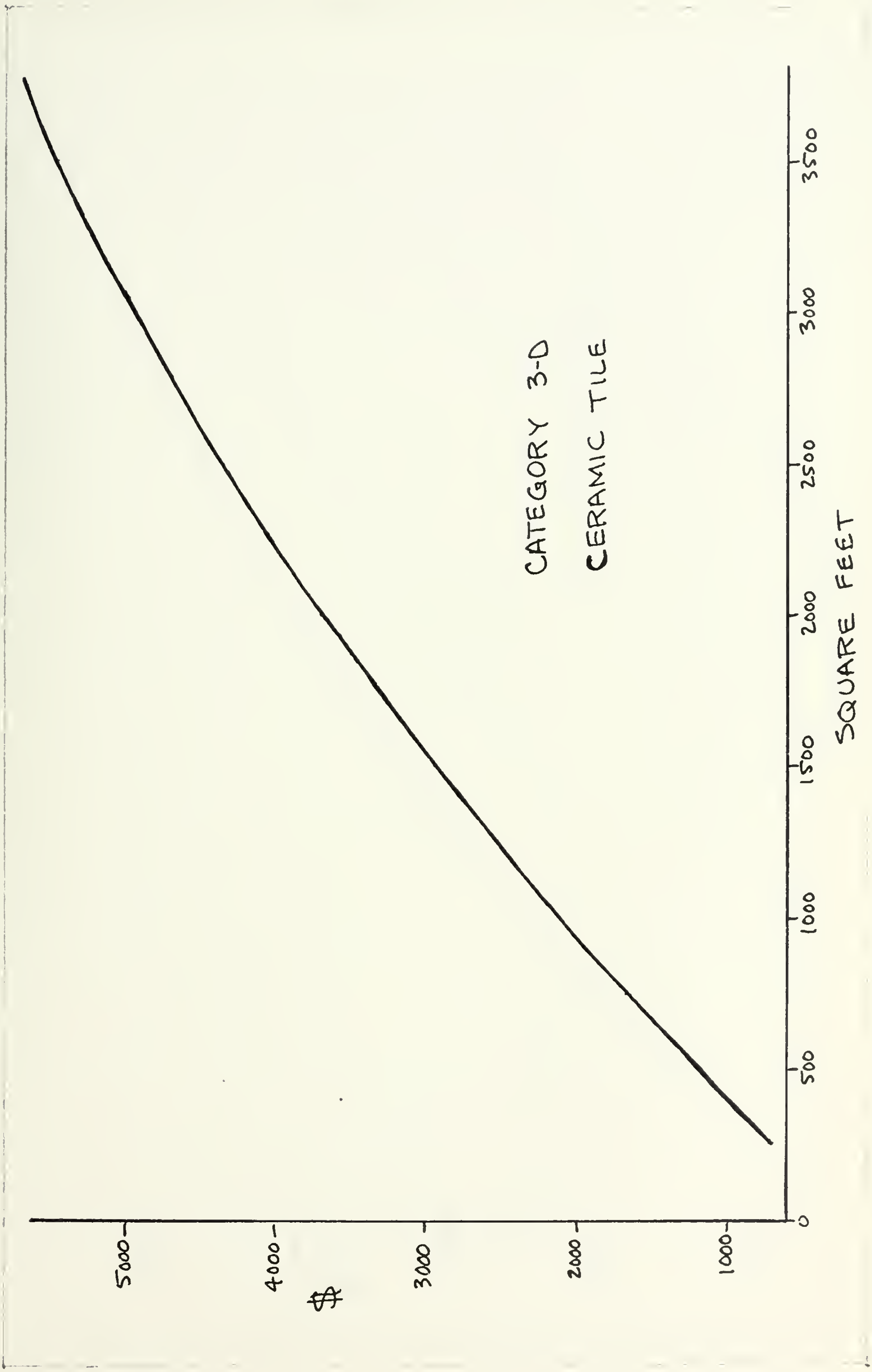

15000
12500
10000
$
7500
5000
2500
0
5
10
15
20
25
30
35
TONS
CATEGORY 2-B
STRUCTURAL STEEL


CATEGORY 2-C
WOOD FRAMING
BOARD FEET
$
0
200
400
600
800
1000
500
1000
1500
2000
2500


CATEGORY 3-A
FLOOR TILE
SQUARE FEET
$
0
1000
2000
3000
4000
5000
6000
7000
0
500
1000
1500
2000


CATEGORY 3-B
CARPETING
SQUARE FEET
$
0
500
1000
1500
2000
2500
3000
3500


CATEGORY 3-C
UNDERLAYMENT
SQUARE FEET
$
0
2000
4000
6000
8000
10000
12000
1250
1500
1750
2000
2250
2500


CATEGORY 3-D
CERAMIC TILE
SQUARE FEET
$
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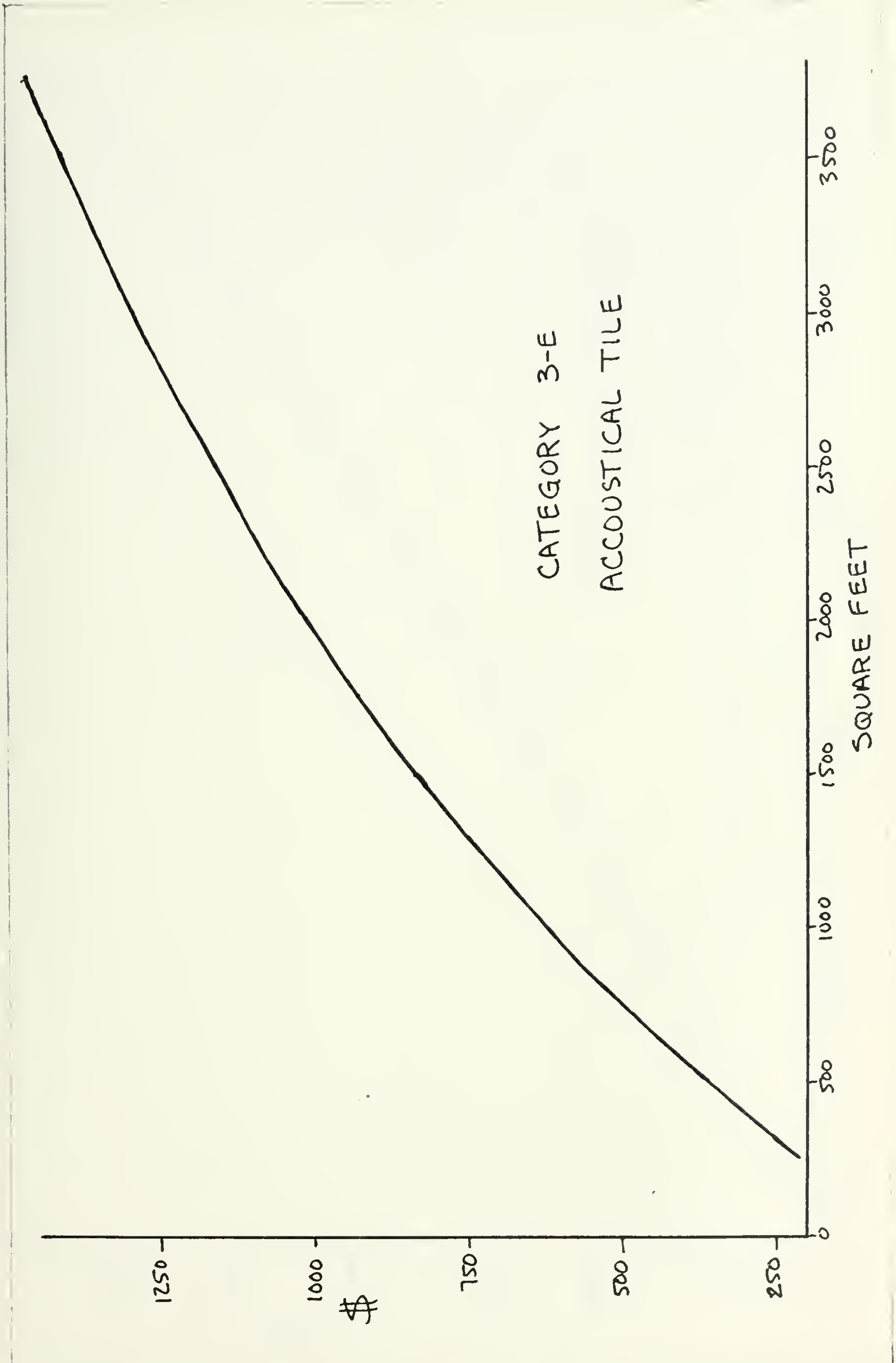
500
1000
1500
2000
2500
3000
3500
1000
2000
3000
4000
5000


CATEGORY 3-E
ACCOUSTICAL TILE
SQUARE FEET
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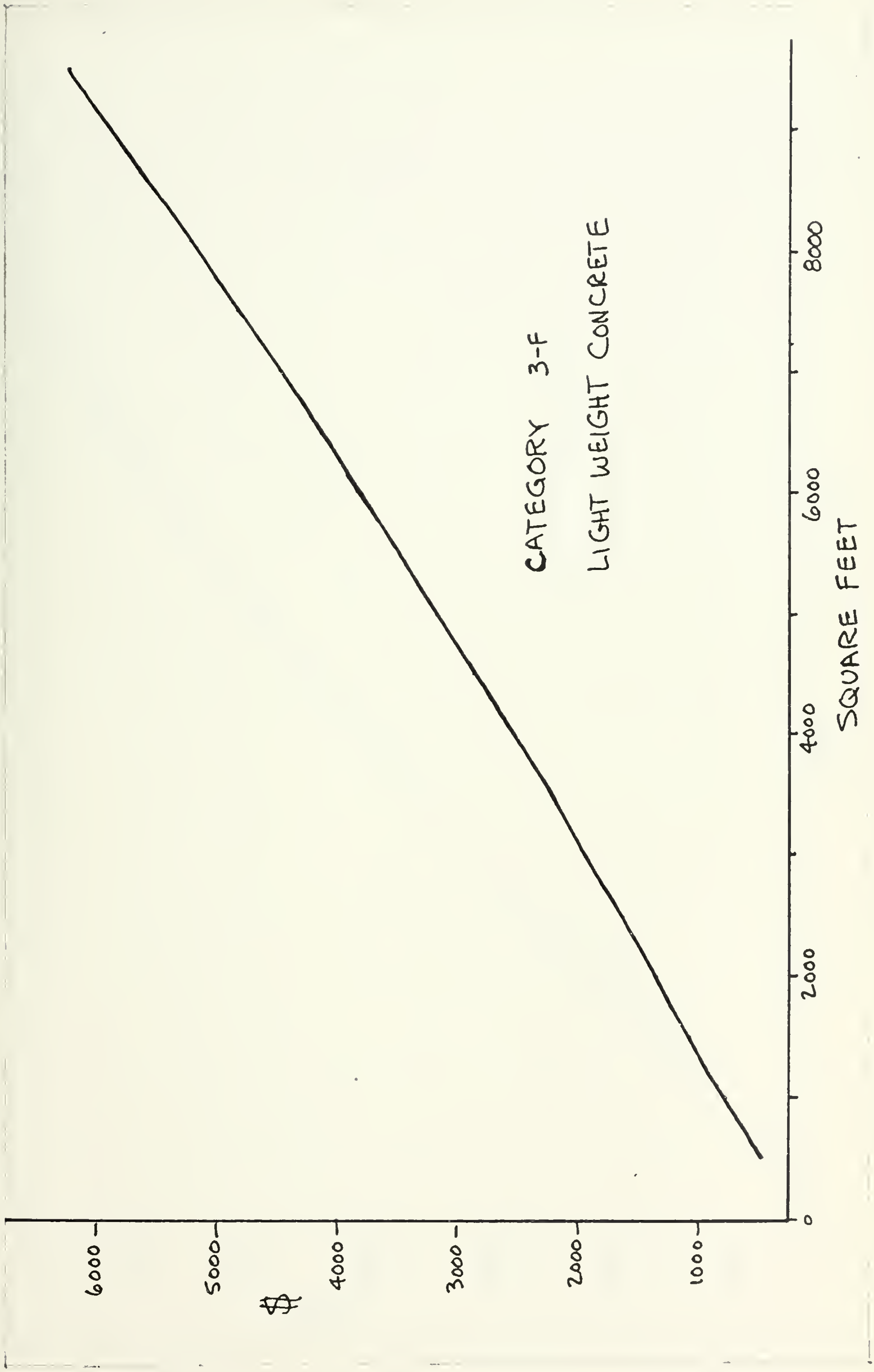
1000
1500
2000
2500
3000
3500
250
500
750
1000
1250


CATEGORY 3-F
LIGHT WEIGHT CONCRETE
SQUARE FEET
$
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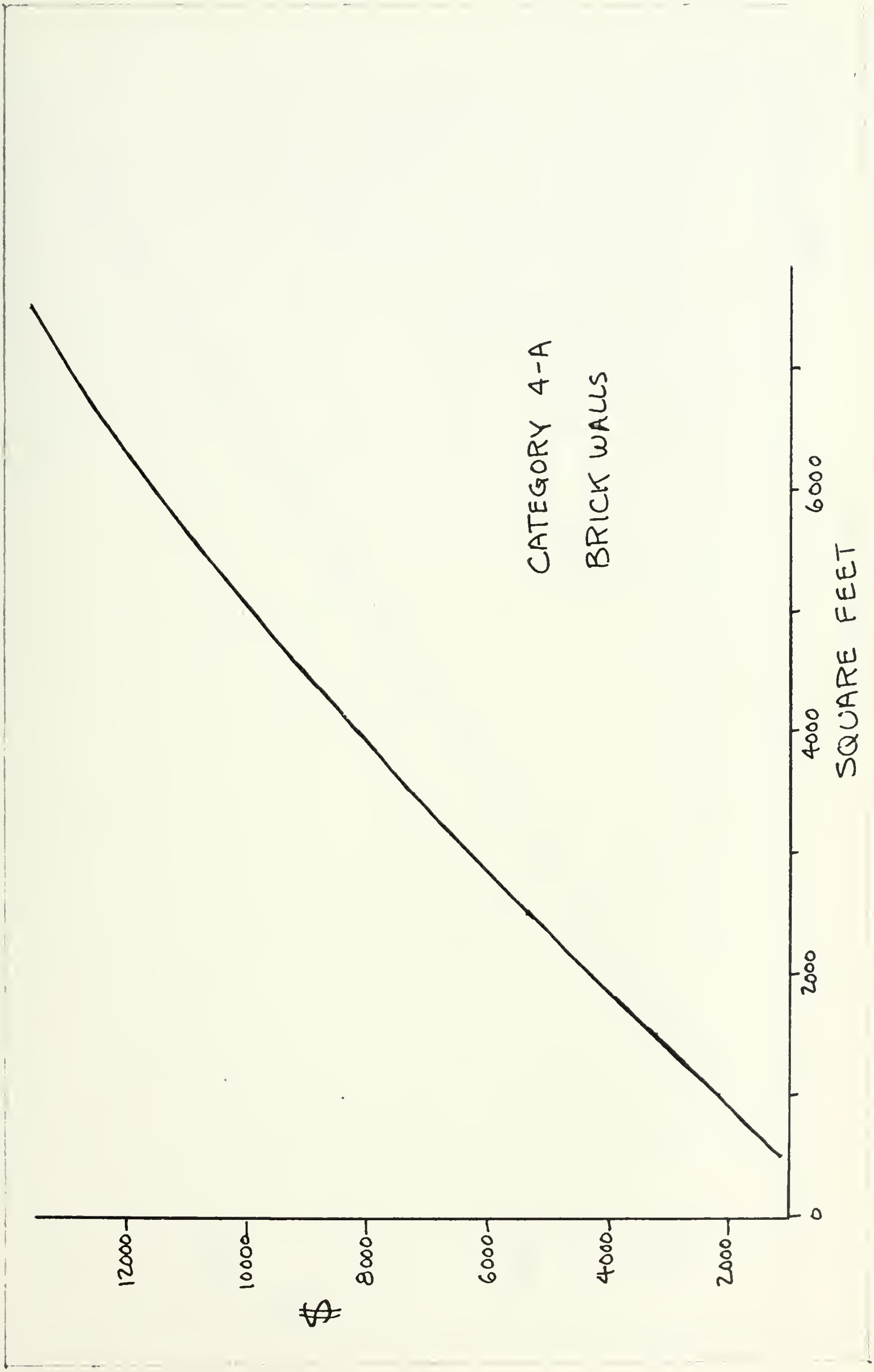
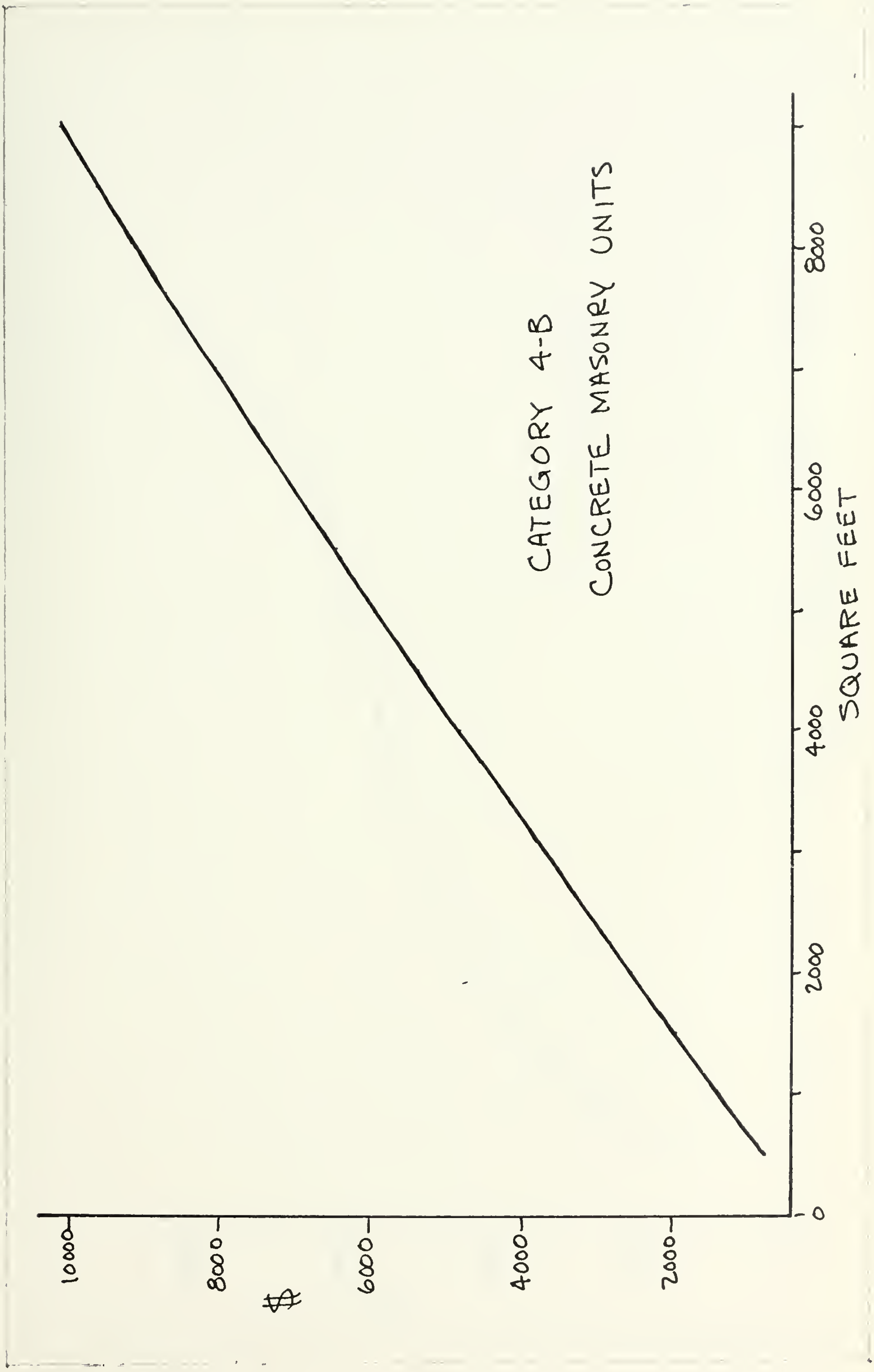
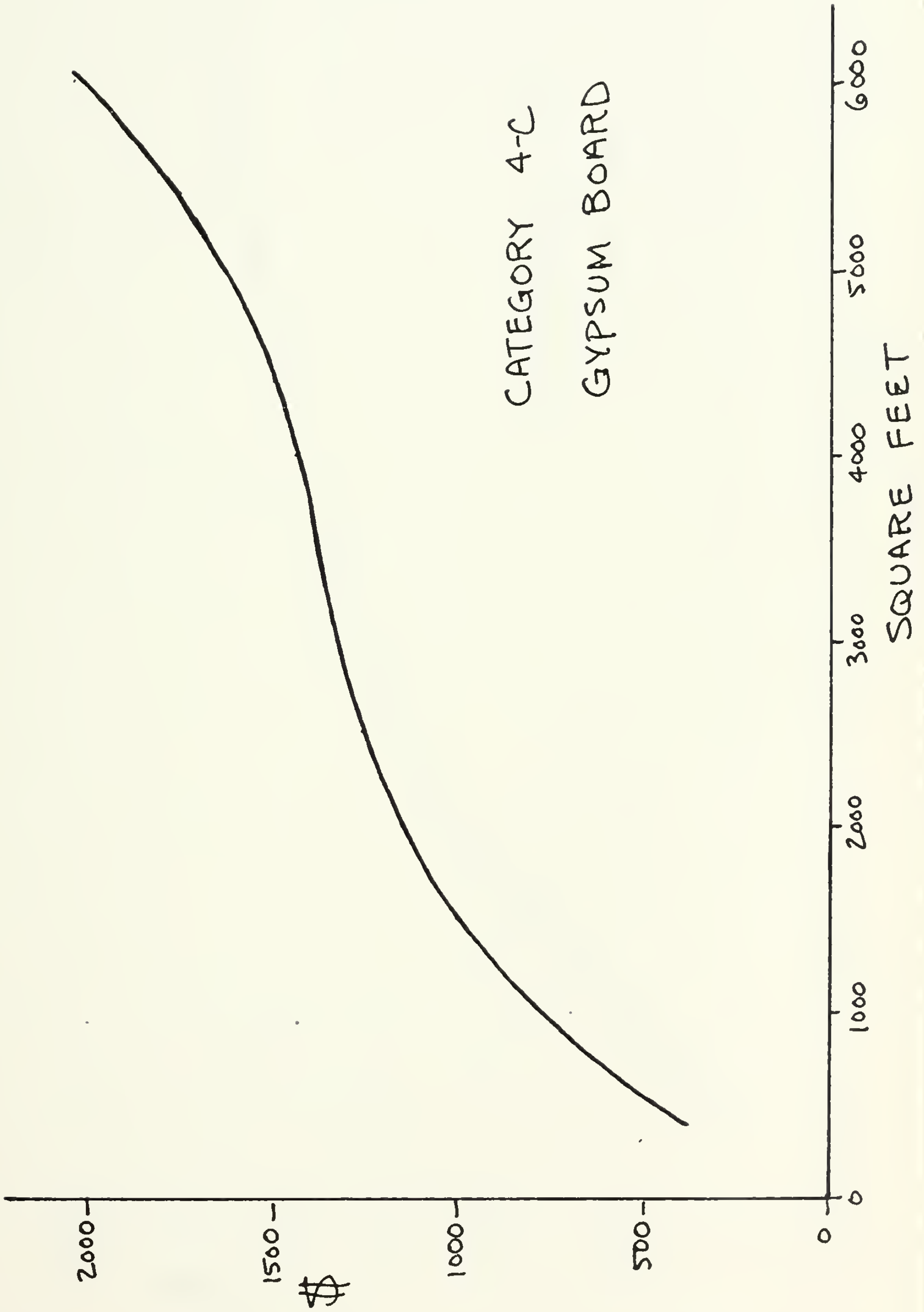
1000
2000
3000
4000
5000
6000
8000



CATEGORY 4-A
BRICK WALLS
SQUARE FEET
$
0
2000
4000
6000
8000
10000
12000


CATEGORY 4-B
CONCRETE MASONRY UNITS
SQUARE FEET
$
0
2000
4000
6000
8000
10000


CATEGORY 4-C
GYPSUM BOARD
SQUARE FEET
$
0
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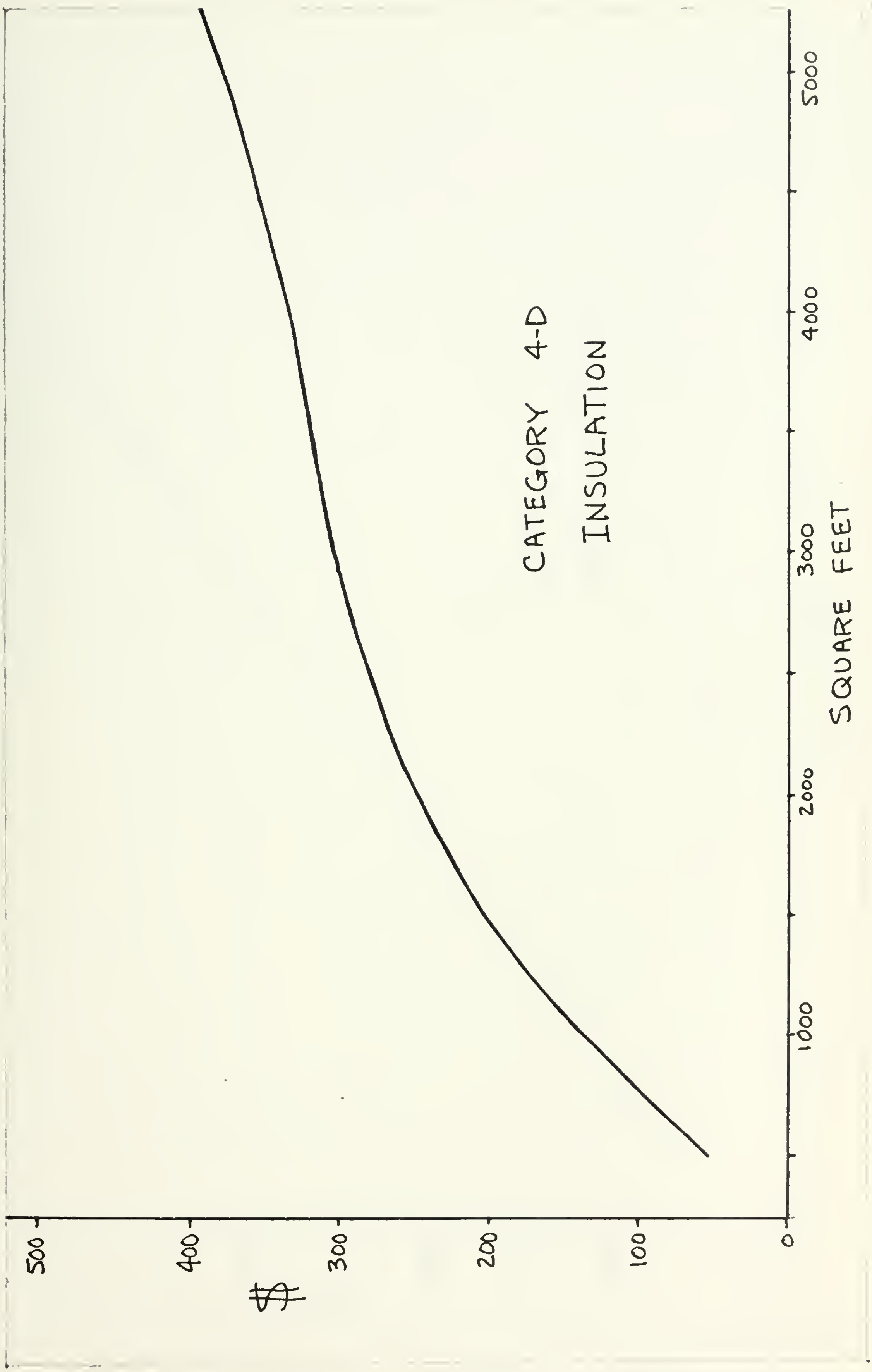
1000
1500
2000
0
1000
2000
3000
4000
5000
6000


CATEGORY 4-D
INSULATION
SQUARE FEET
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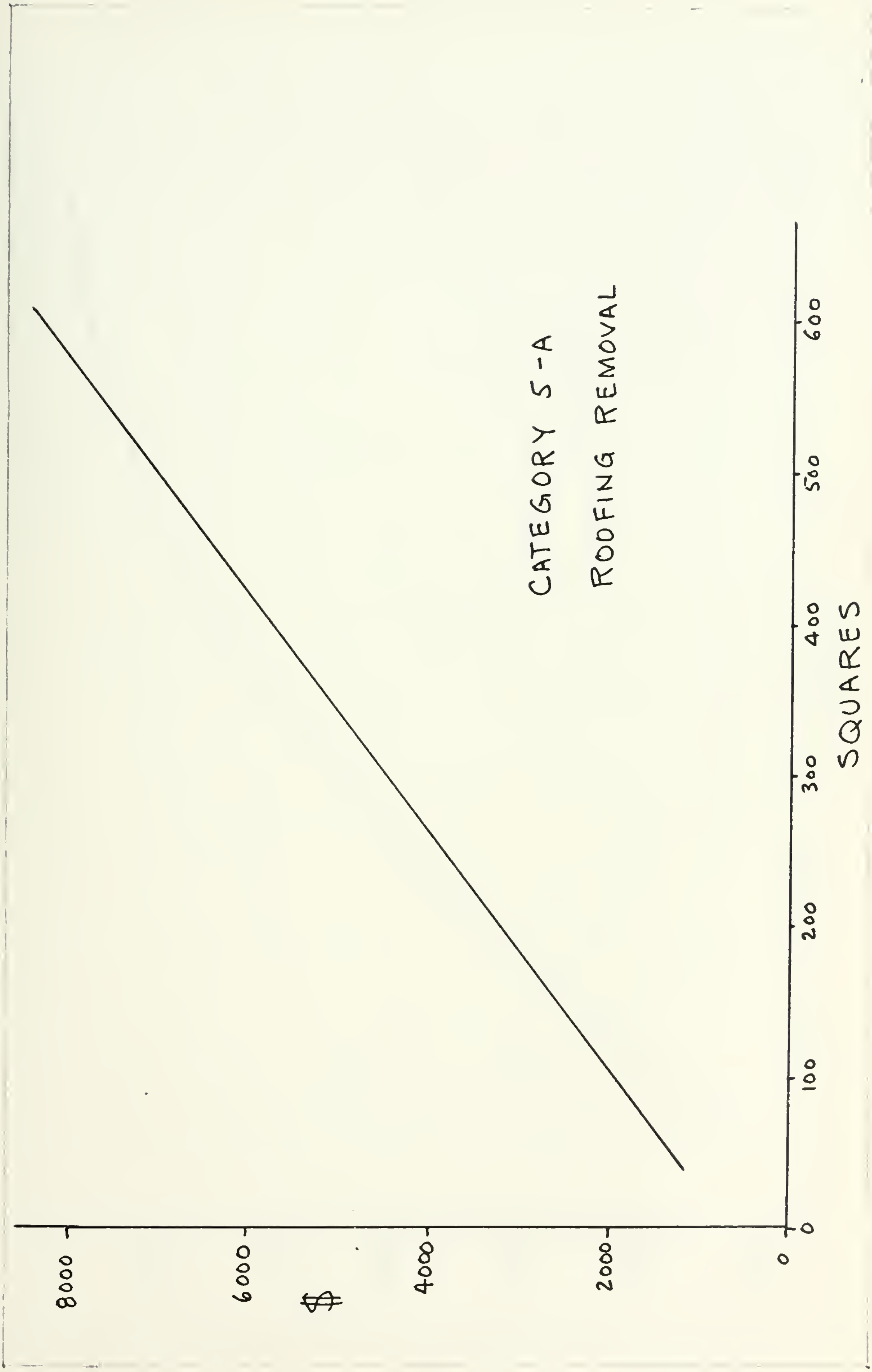
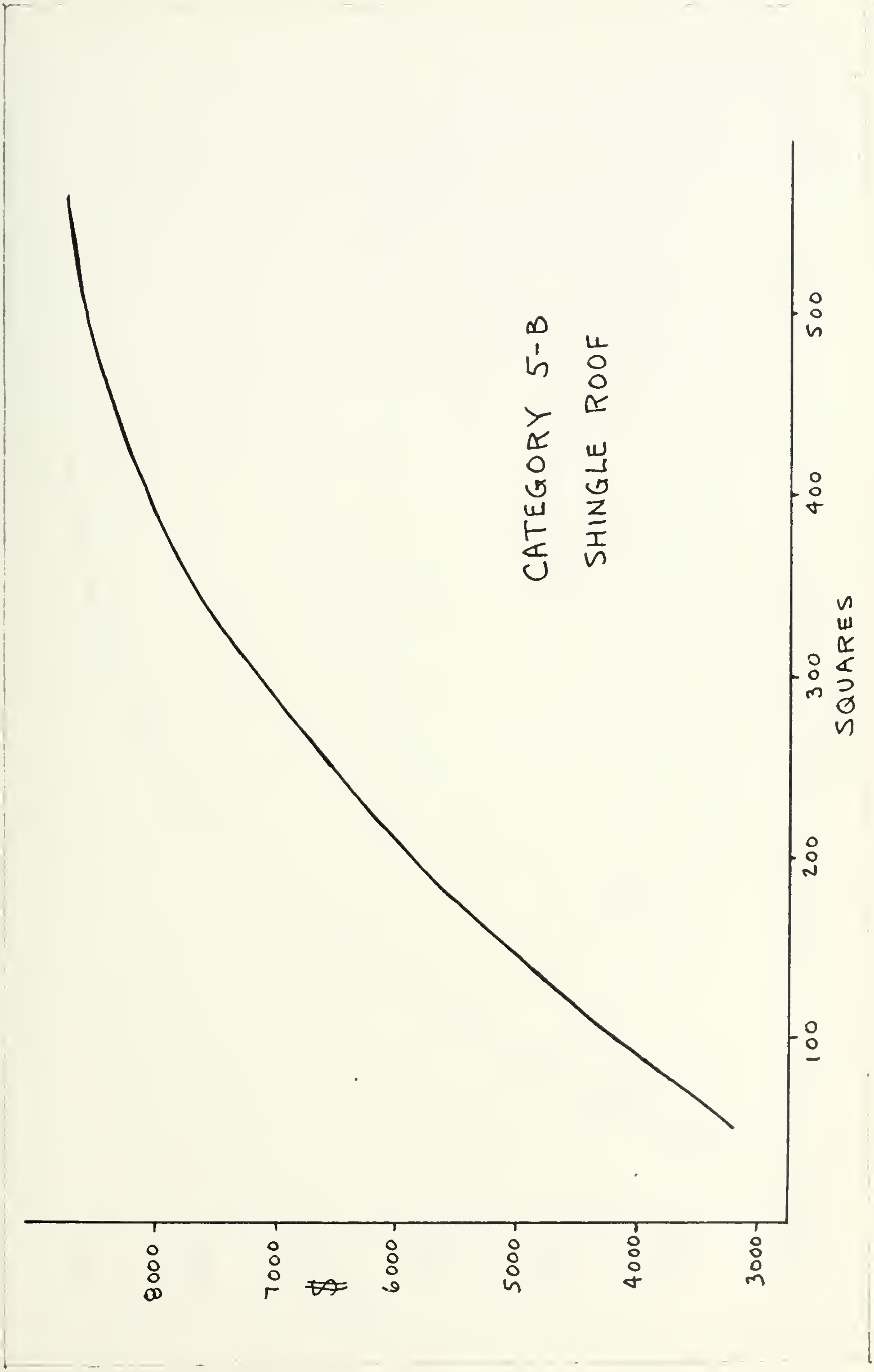
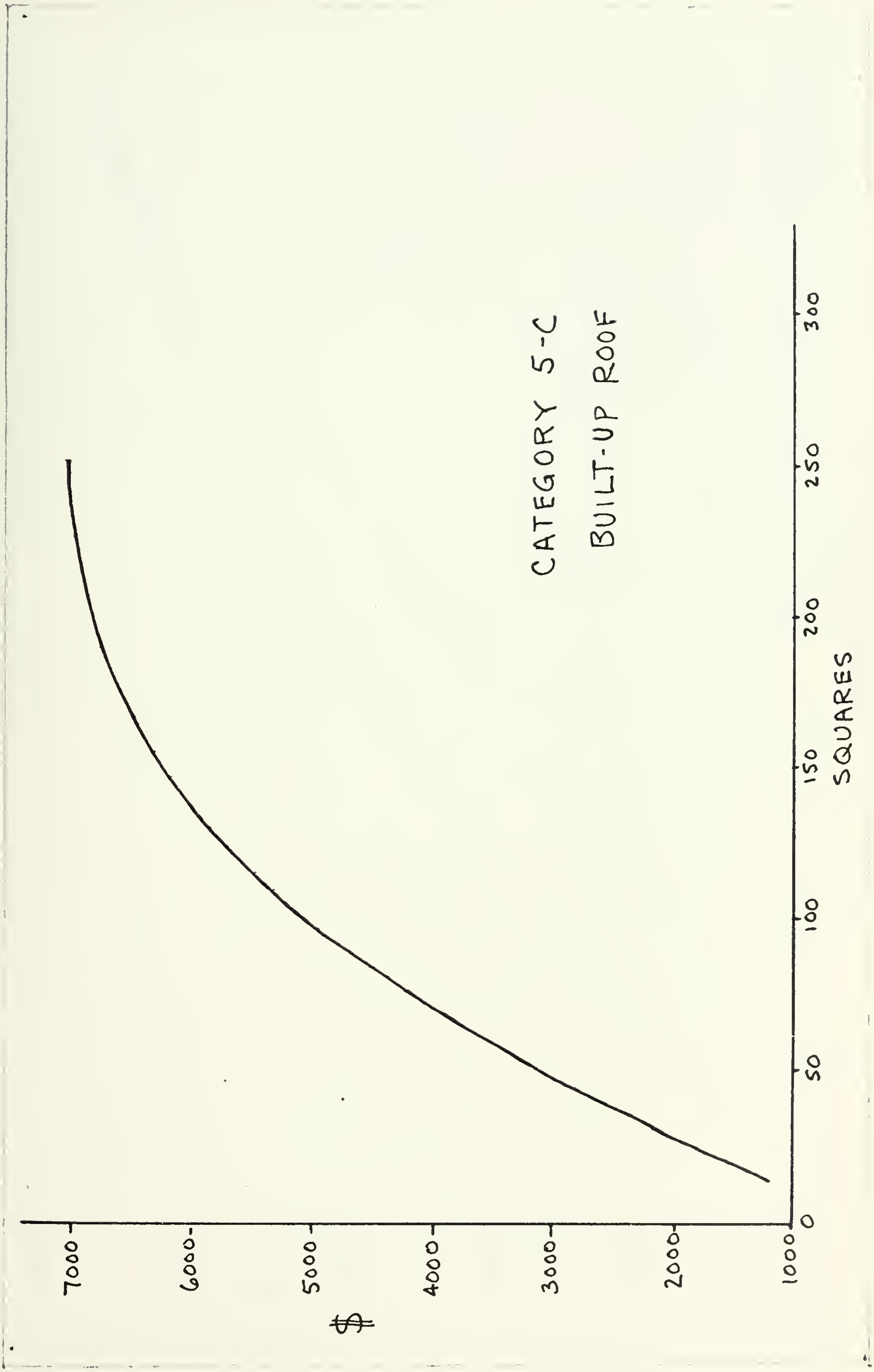
300
400
500
1000
2000
3000
4000
5000


CATEGORY 5-A
ROOFING REMOVAL
$
8000
6000
4000
2000
0
0
100
200
300
400
500
600
SQUARES



CATEGORY 5-B
SHINGLE ROOF
$
8000
7000
6000
5000
4000
3000
100
200
300
400
500
SQUARES


CATEGORY 5-C
BUILT-UP ROOF
SQUARES
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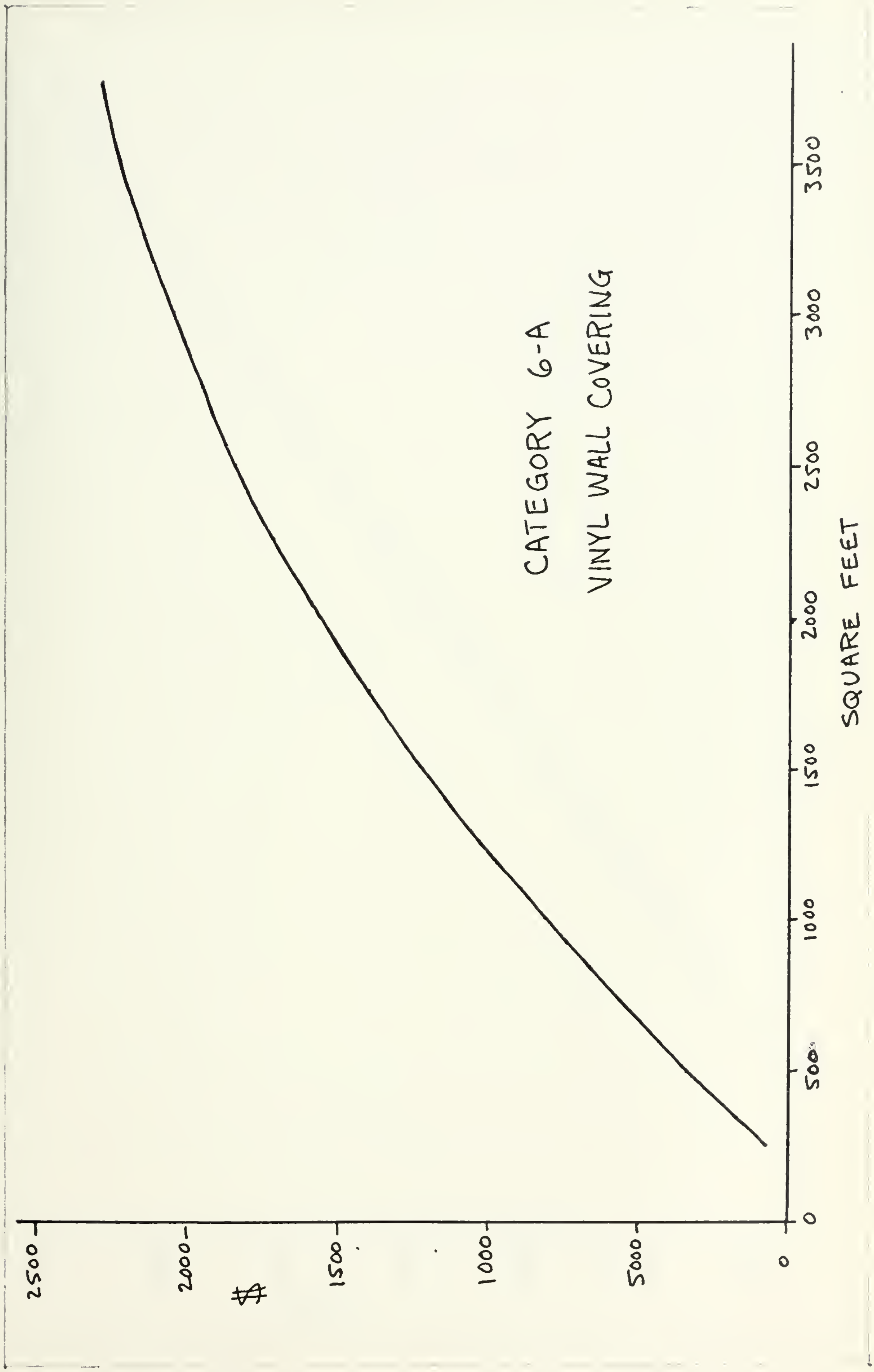
50
100
150
200
250
300
$
1000
2000
3000
4000
5000
6000
7000


CATEGORY 6-A
VINYL WALL COVERING
SQUARE FEET
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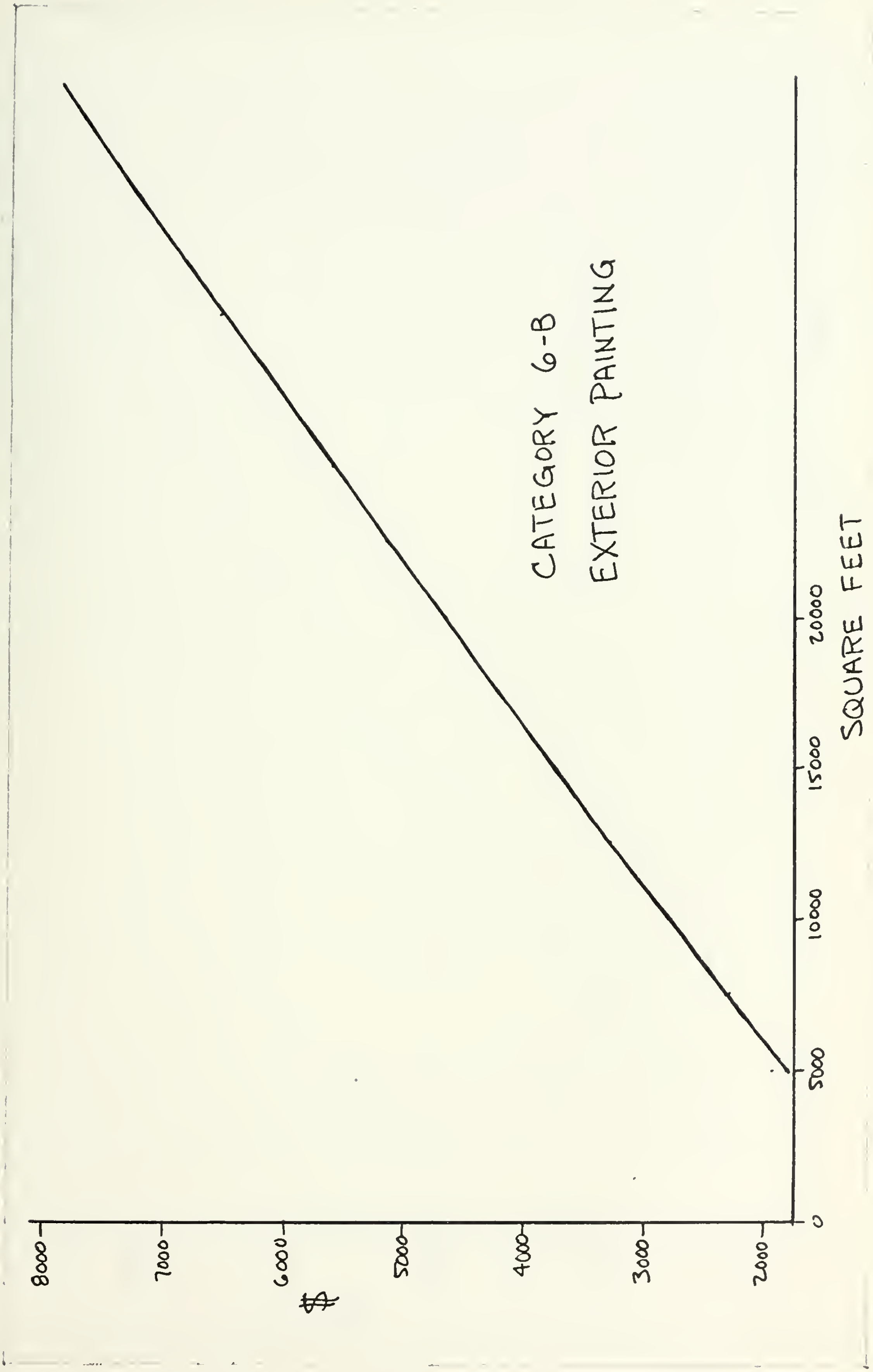
500
1000
1500
2000
2500
3000
3500
0
5000
1000
1500
2000
2500


CATEGORY 6-B
EXTERIOR PAINTING
SQUARE FEET
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7000
6000
5000
4000
3000
2000
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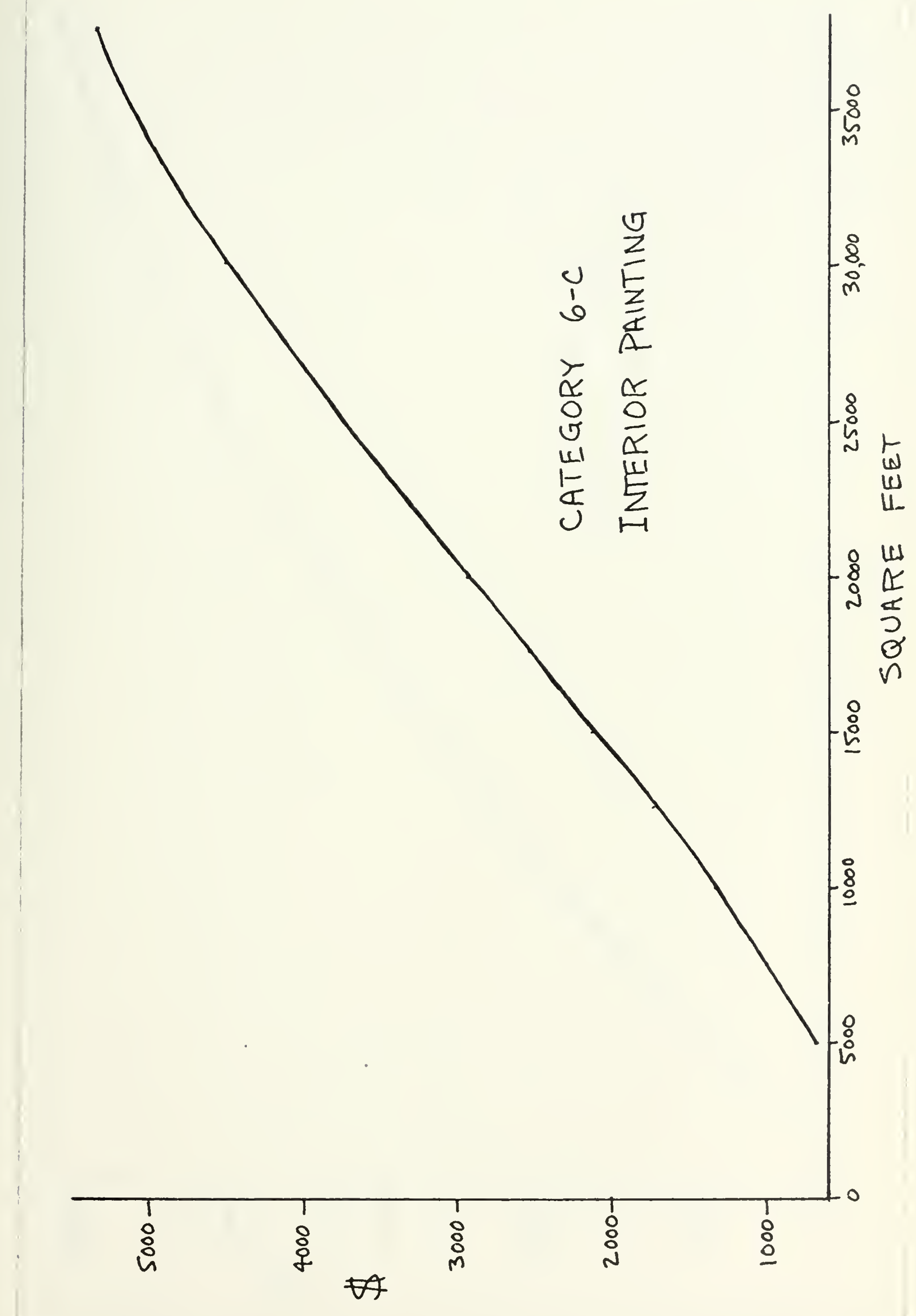
5000
10000
15000
20000


CATEGORY 6-C
INTERIOR PAINTING
SQUARE FEET
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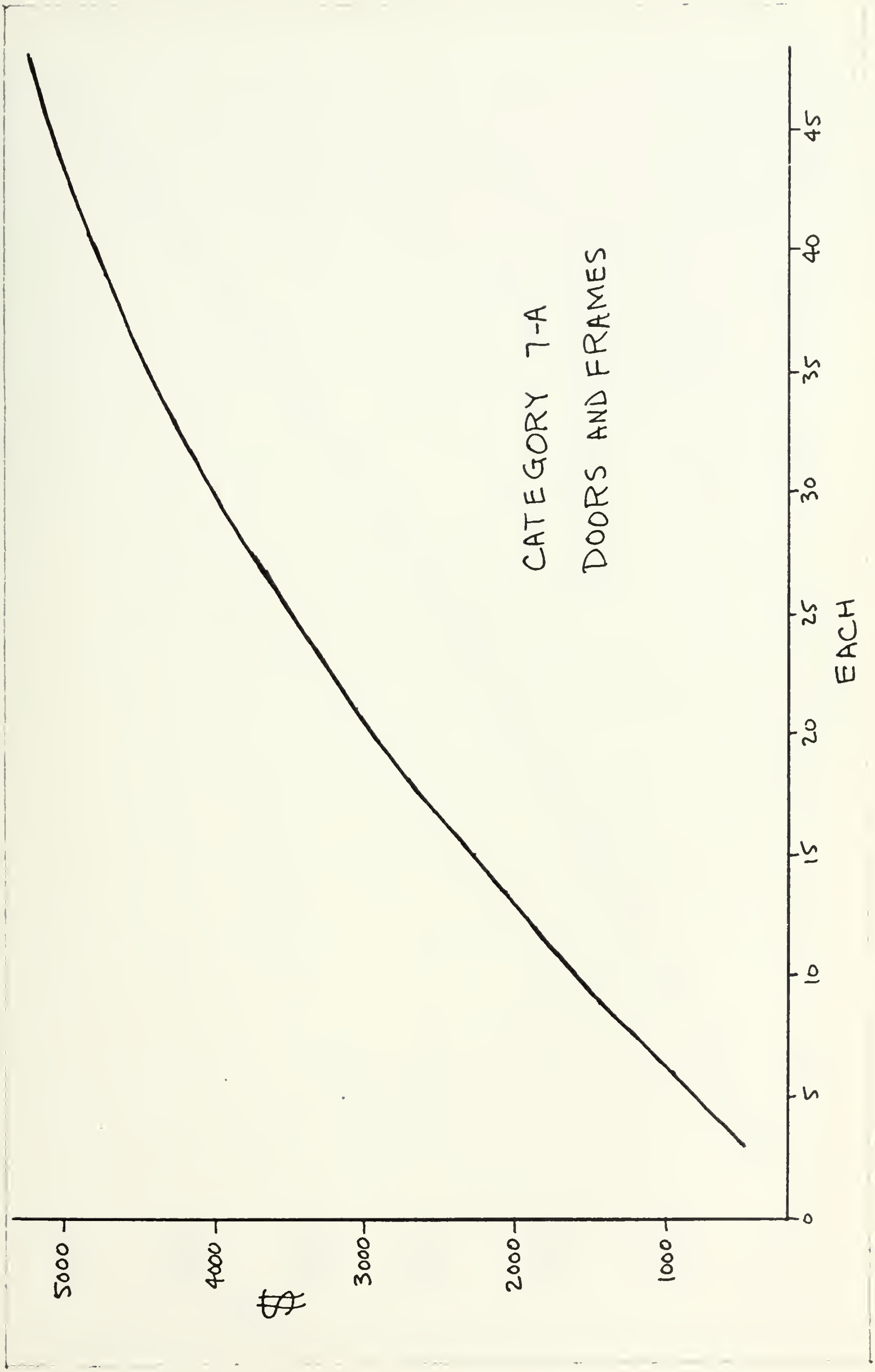
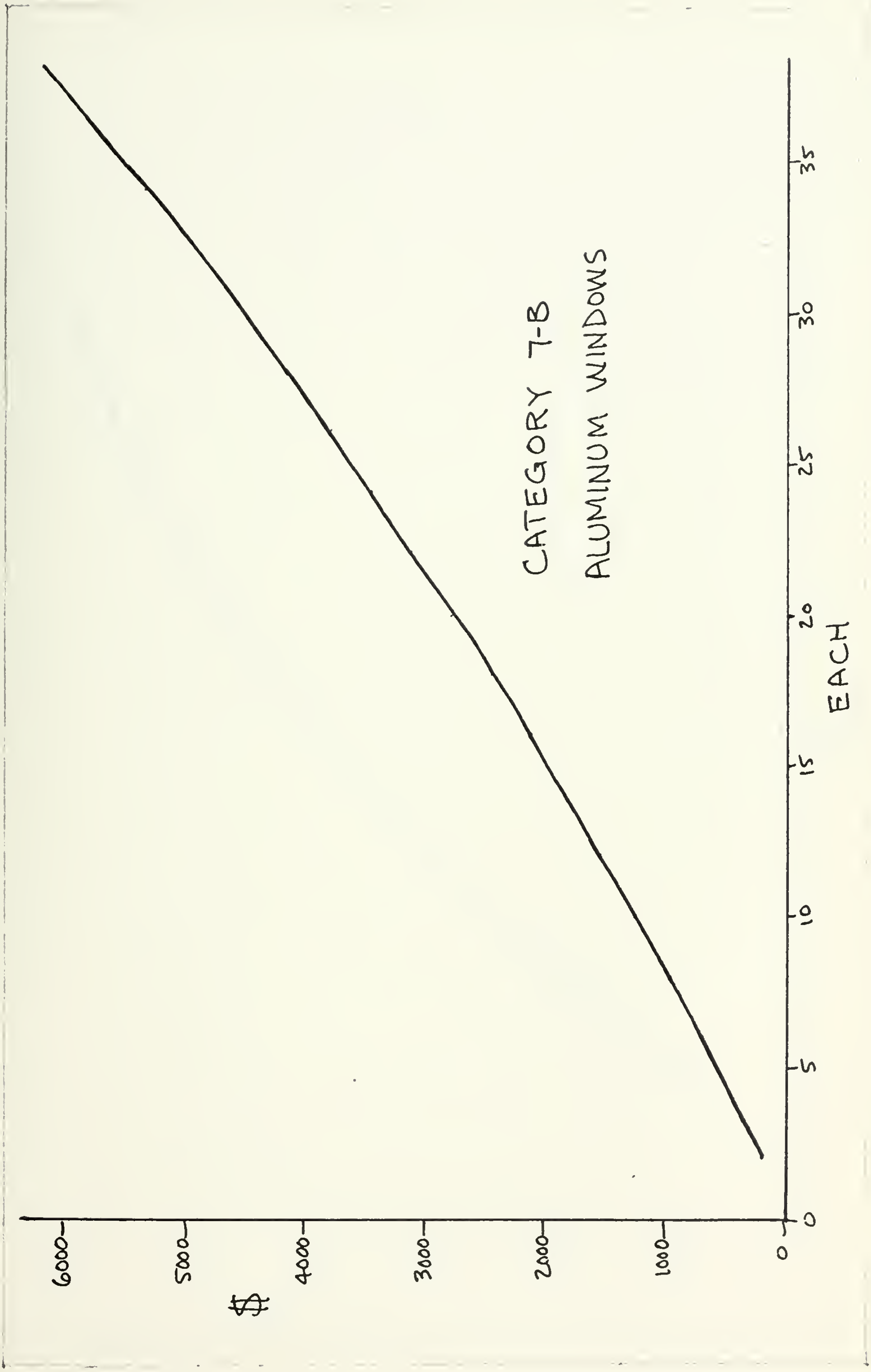
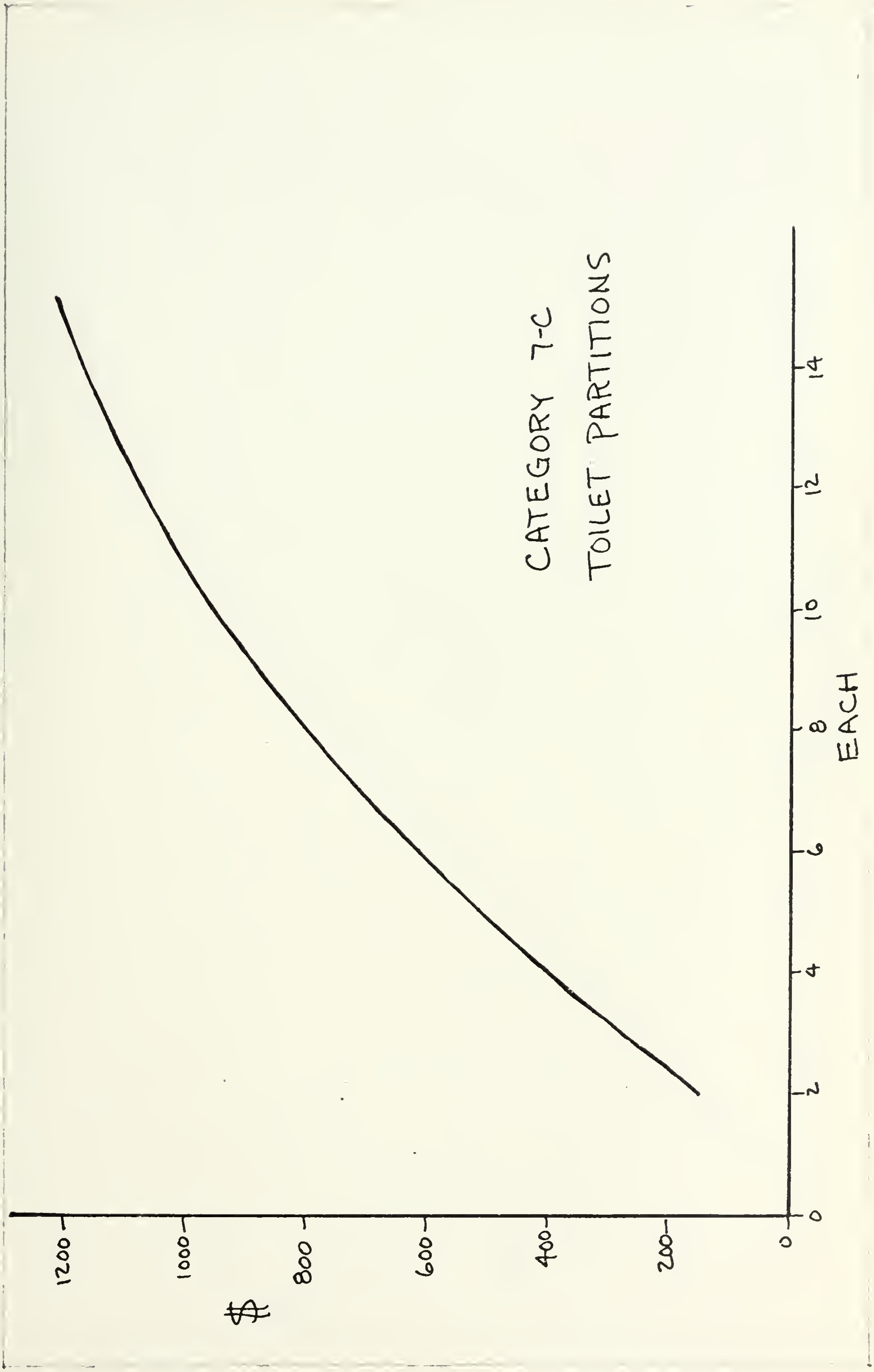
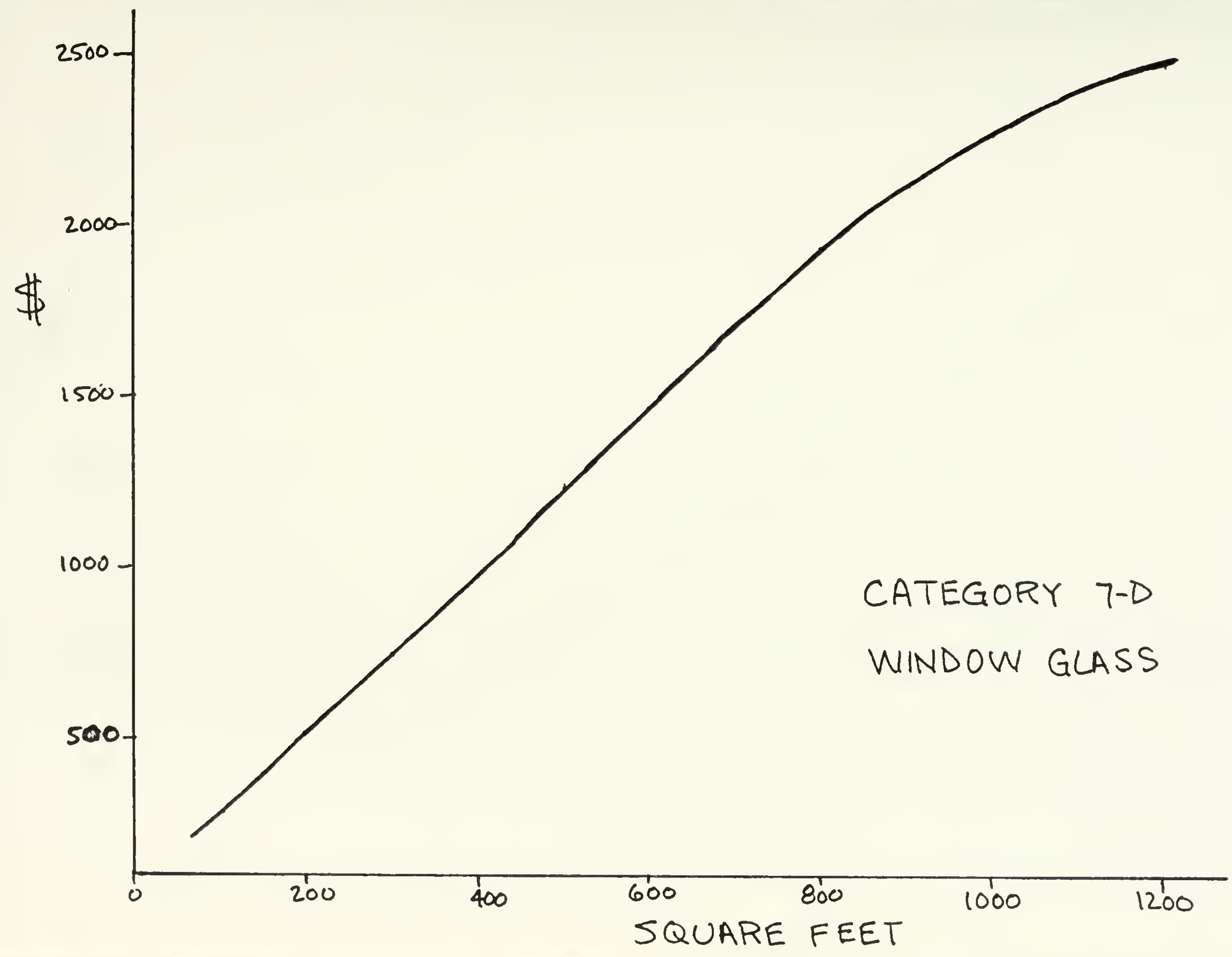
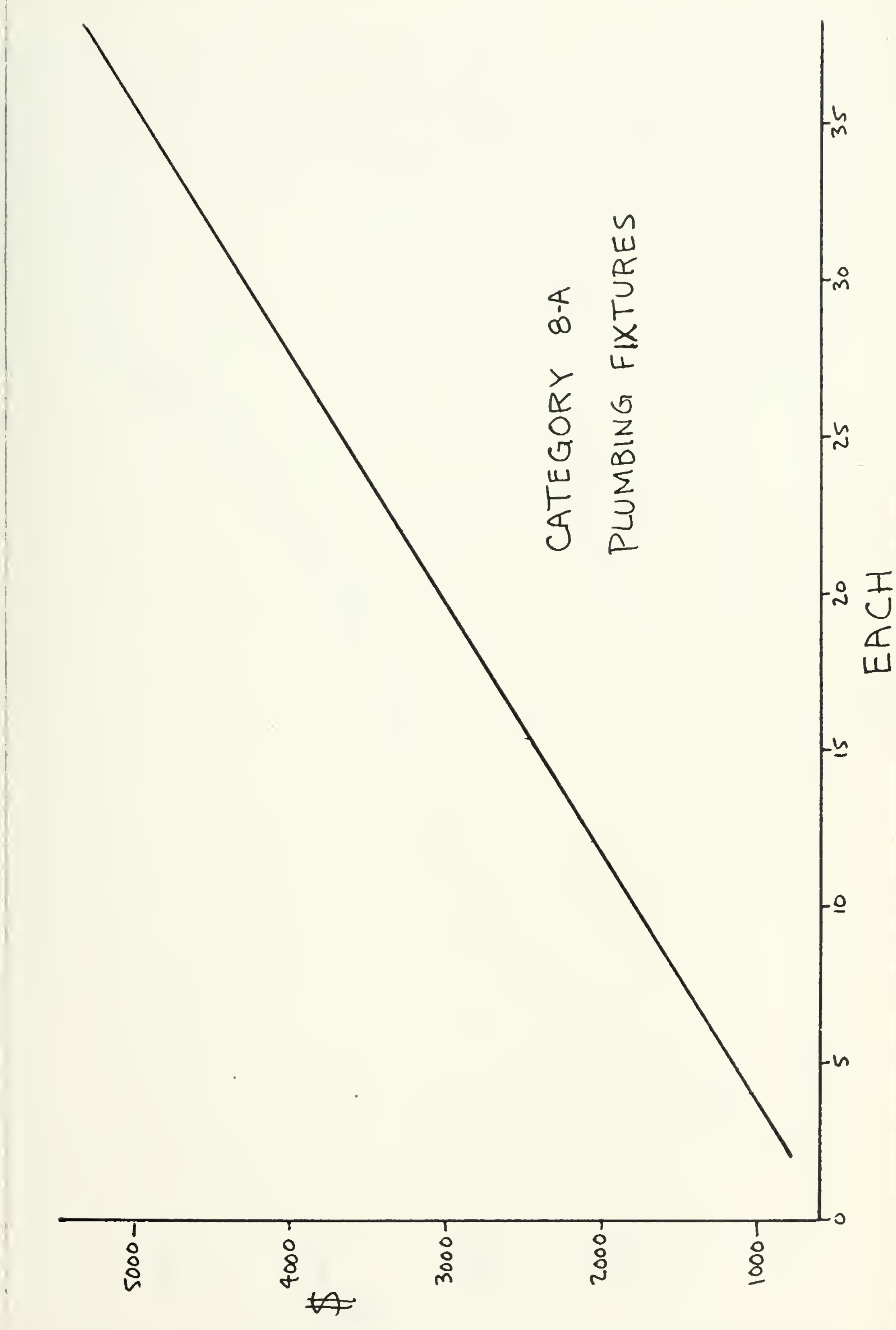
5000
10000
15000
20000
25000
30,000
35000
1000
2000
3000
4000
5000

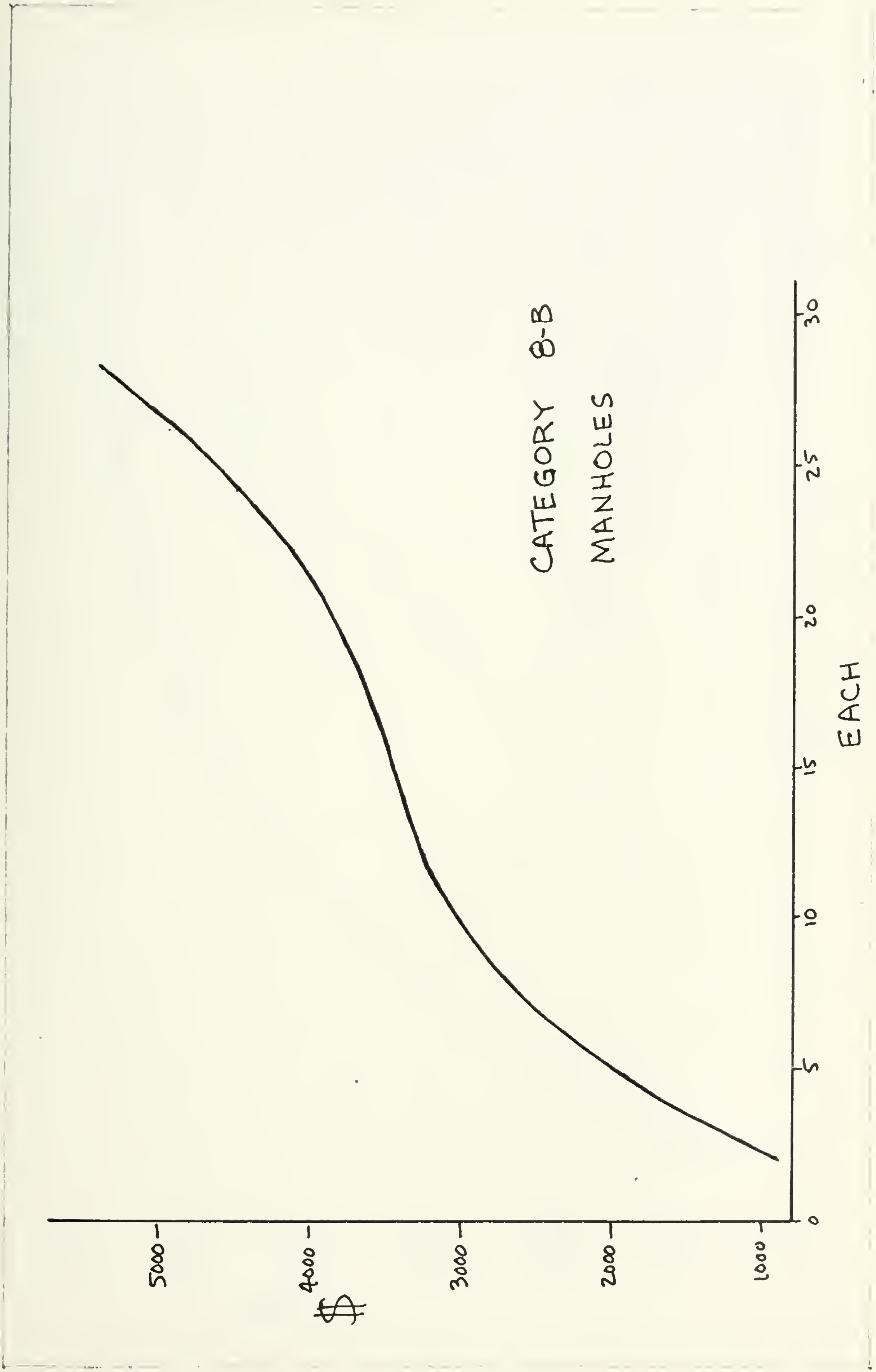

CATEGORY 7-A
DOORS AND FRAMES
EACH
$
0
5
10
15
20
25
30
35
40
45
1000
2000
3000
4000
5000

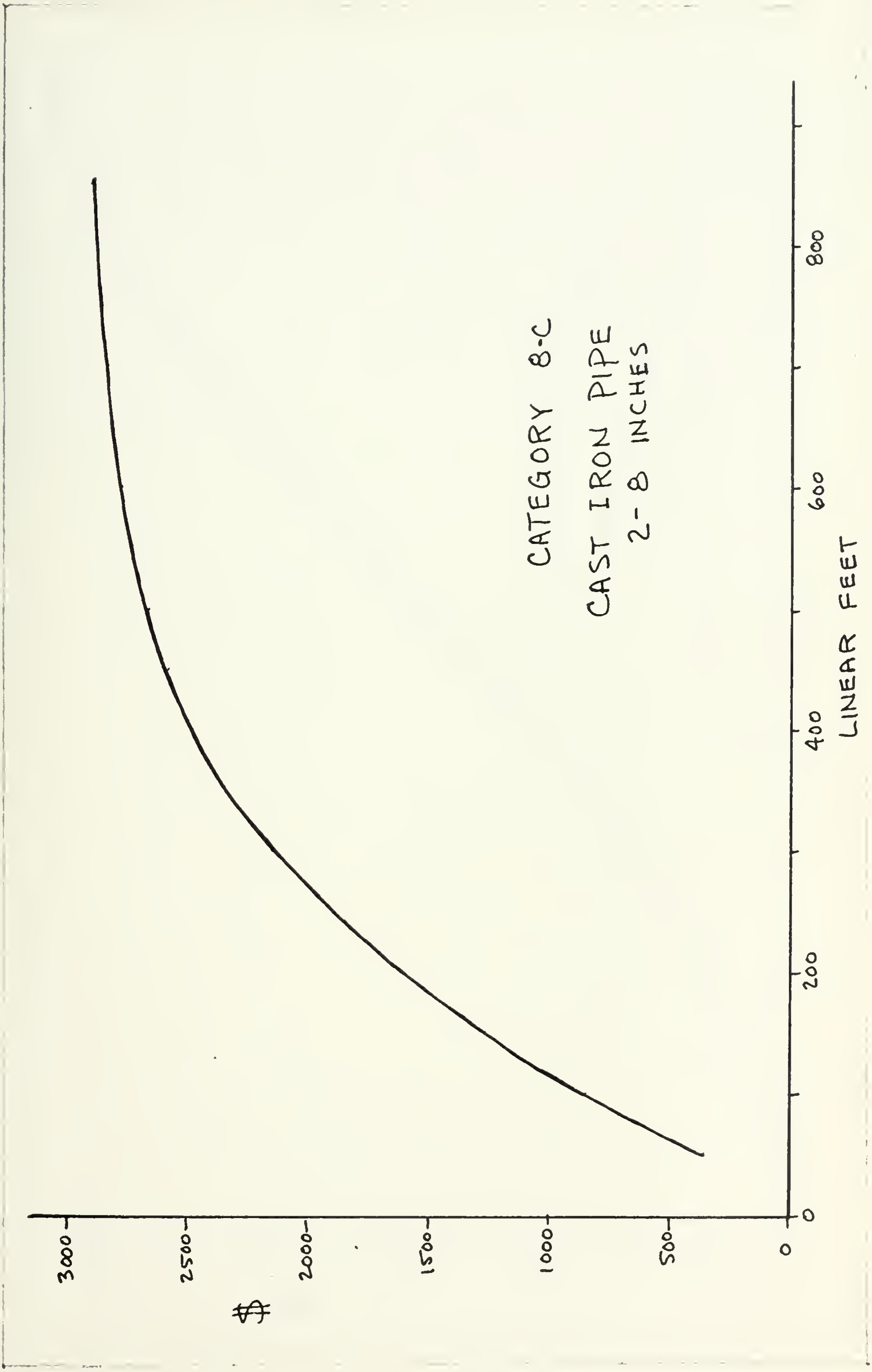

CATEGORY 7-B
ALUMINUM WINDOWS
EACH
$
0
1000
2000
3000
4000
5000
6000
5
10
15
20
25
30
35

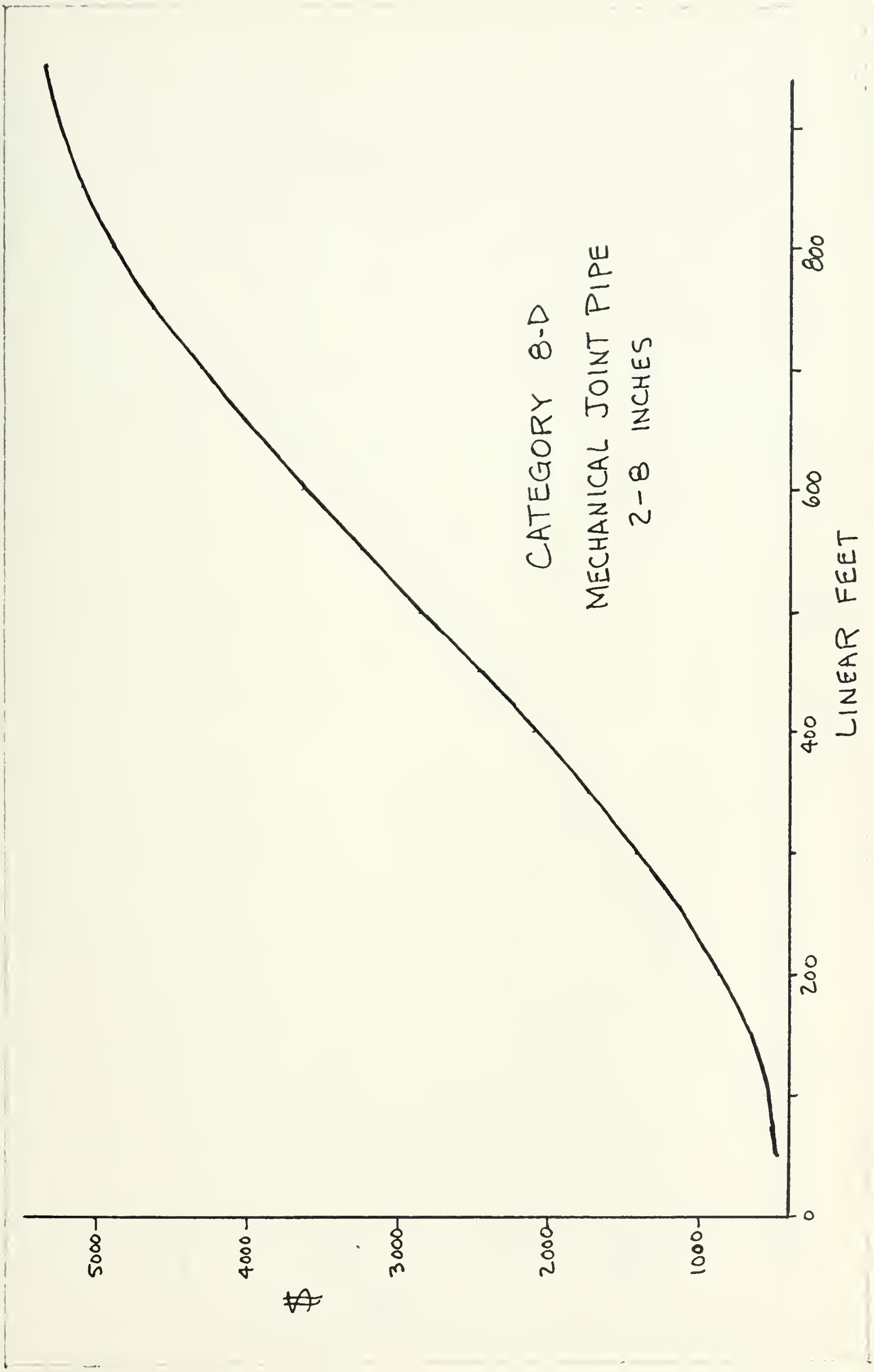

CATEGORY 7-C
TOILET PARTITIONS
$
1200
1000
800
600
400
200
0
EACH
0
2
4
6
8
10
12
14

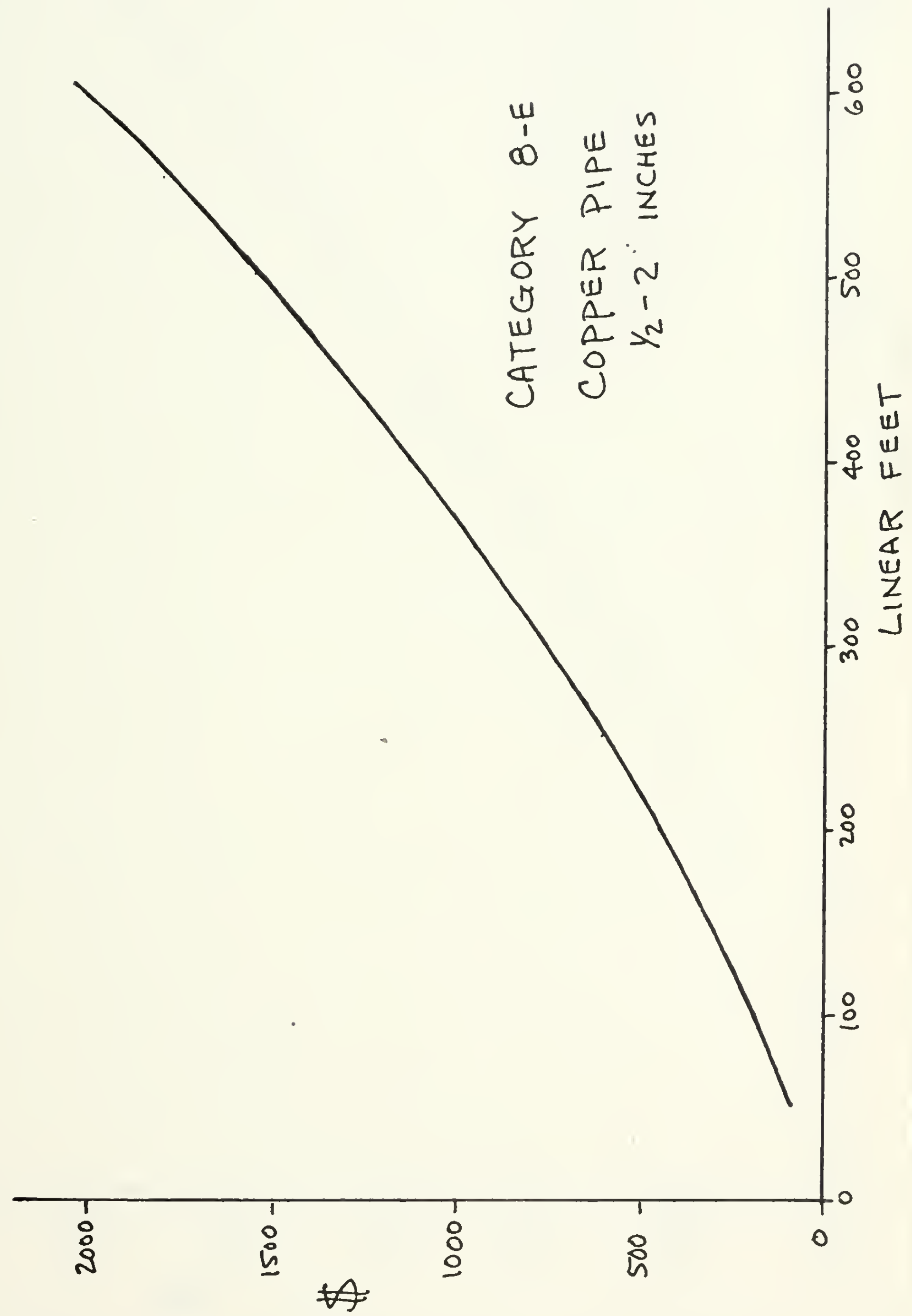

2500
2000
1500
1000
500
$
0
200
400
600
800
1000
1200
SQUARE FEET
CATEGORY 7-D
WINDOW GLASS

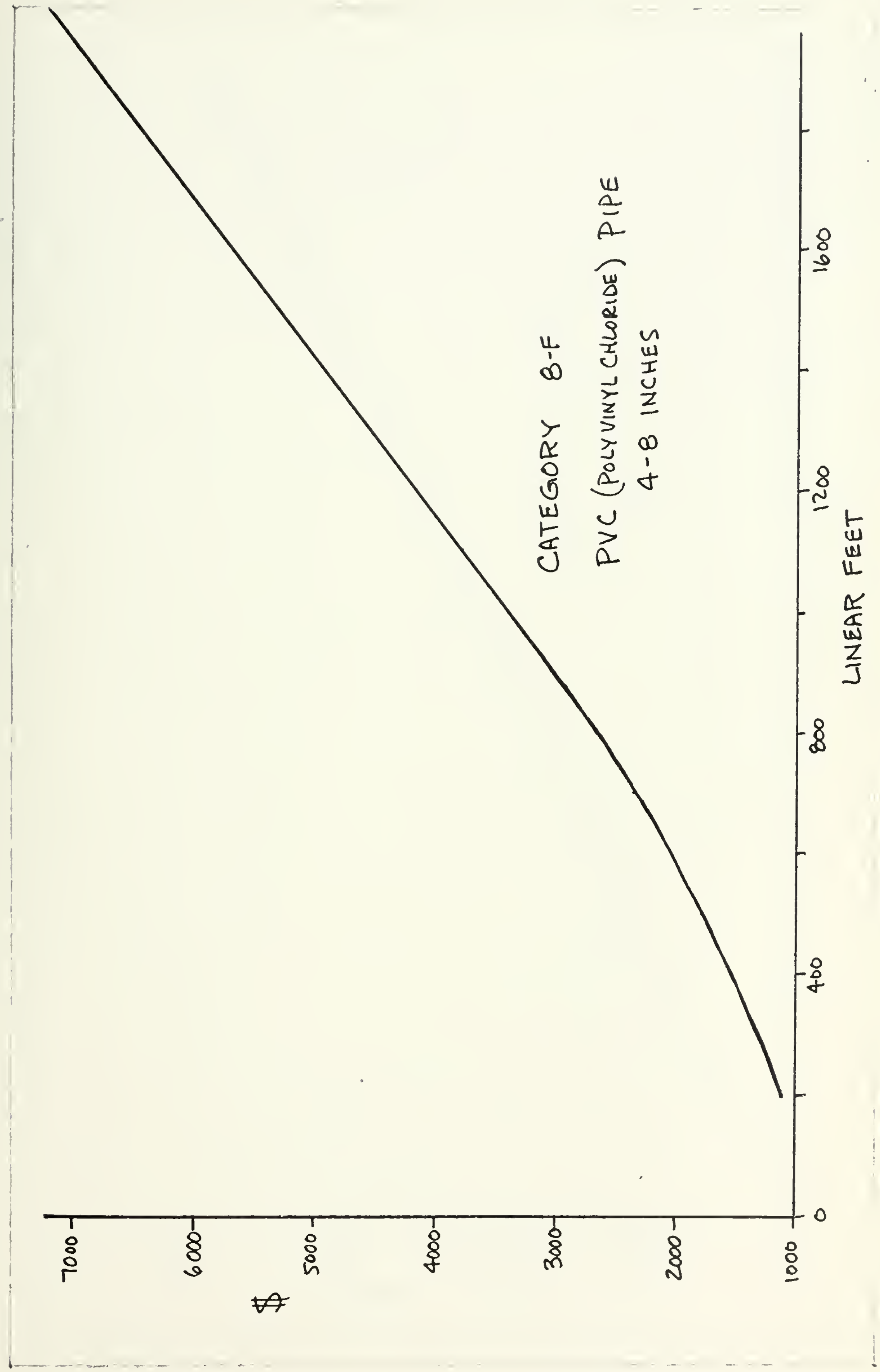

CATEGORY 8-A
PLUMBING FIXTURES
EACH
$
0
5
10
15
20
25
30
35
1000
2000
3000
4000
5000

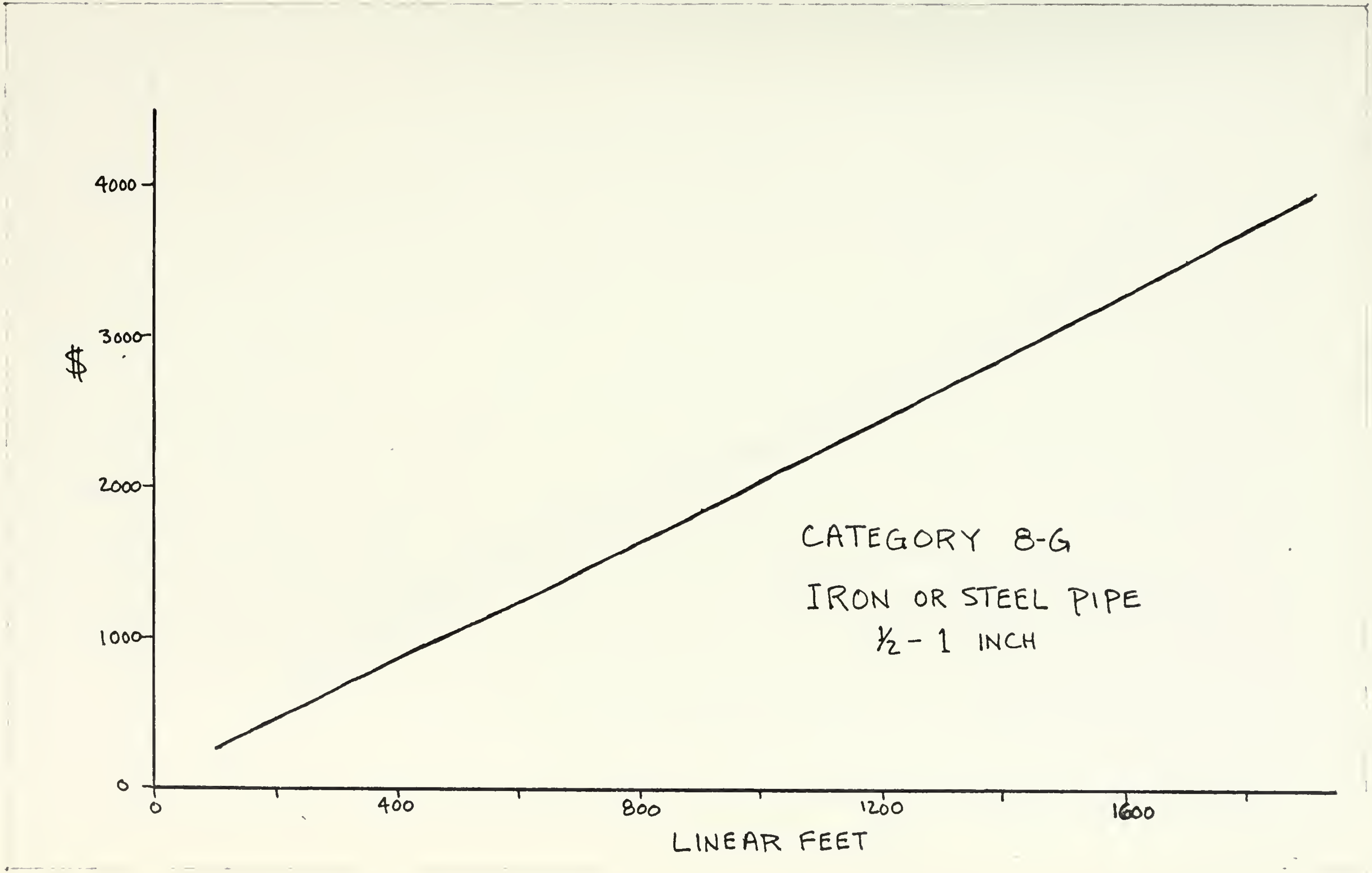

CATEGORY 8-B
MANHOLES
EACH
$
5000
4000
3000
2000
1000
0
5
10
15
20
25
30

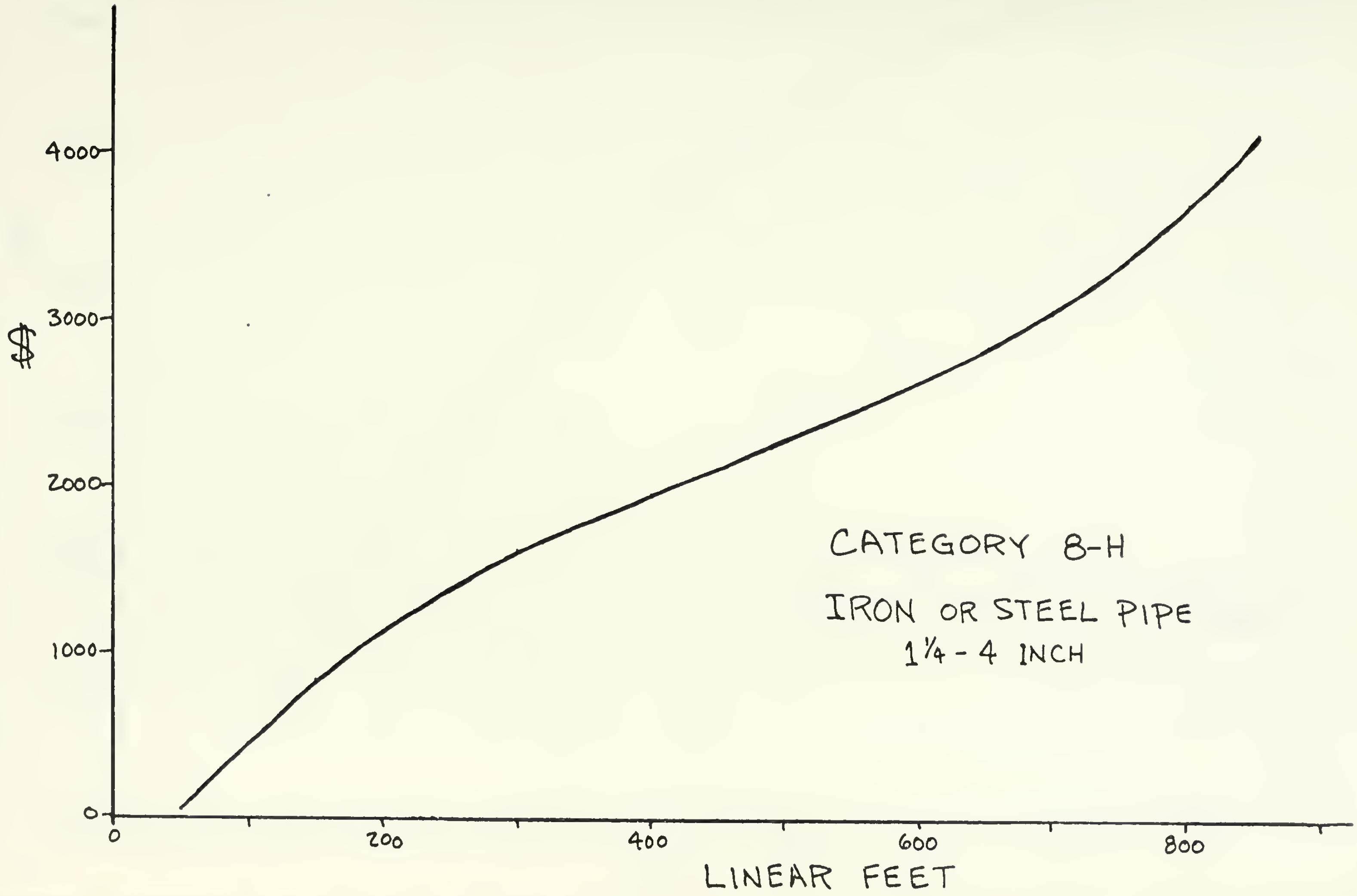

CATEGORY 8-C
CAST IRON PIPE
2- 8 INCHES
LINEAR FEET
$
0
500
1000
1500
2000
2500
3000
0
200
400
600
800

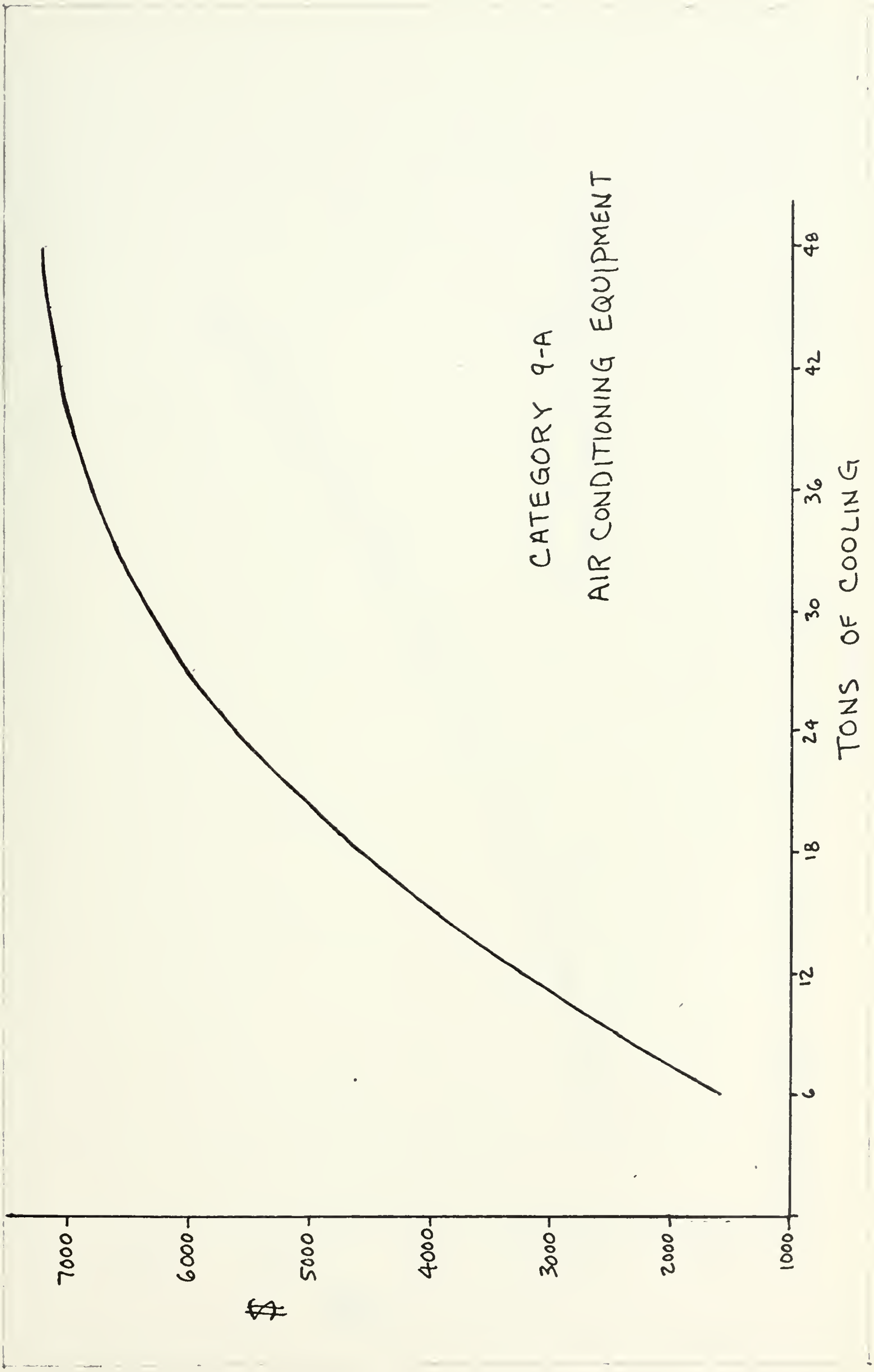

CATEGORY 8-D
MECHANICAL JOINT PIPE
2-8 INCHES
LINEAR FEET
$
0
200
400
600
800
1000
2000
3000
4000
5000

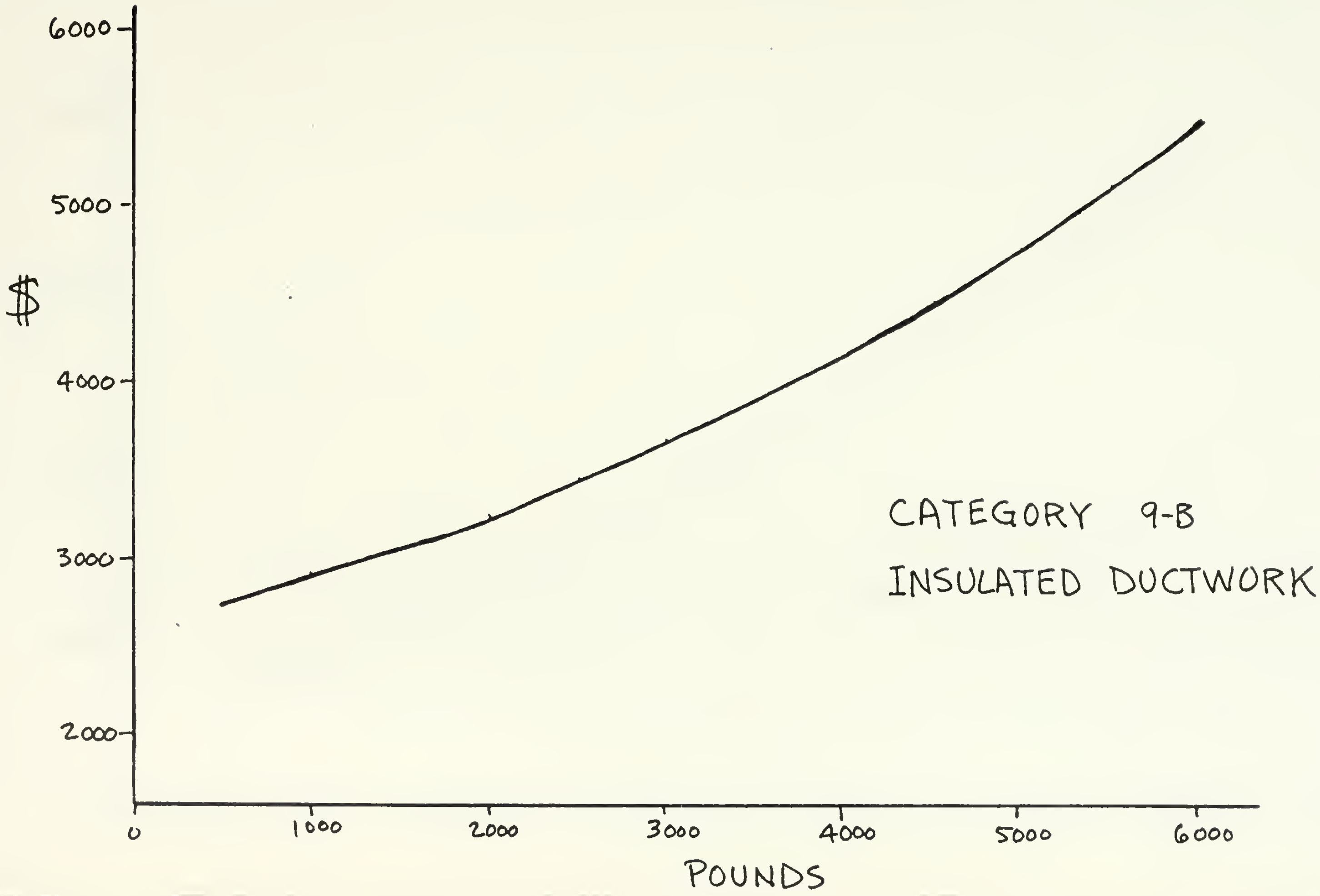

CATEGORY 8-E
COPPER PIPE
½ - 2" INCHES
$
2000
1500
1000
500
0
100
200
300
400
500
600
LINEAR FEET

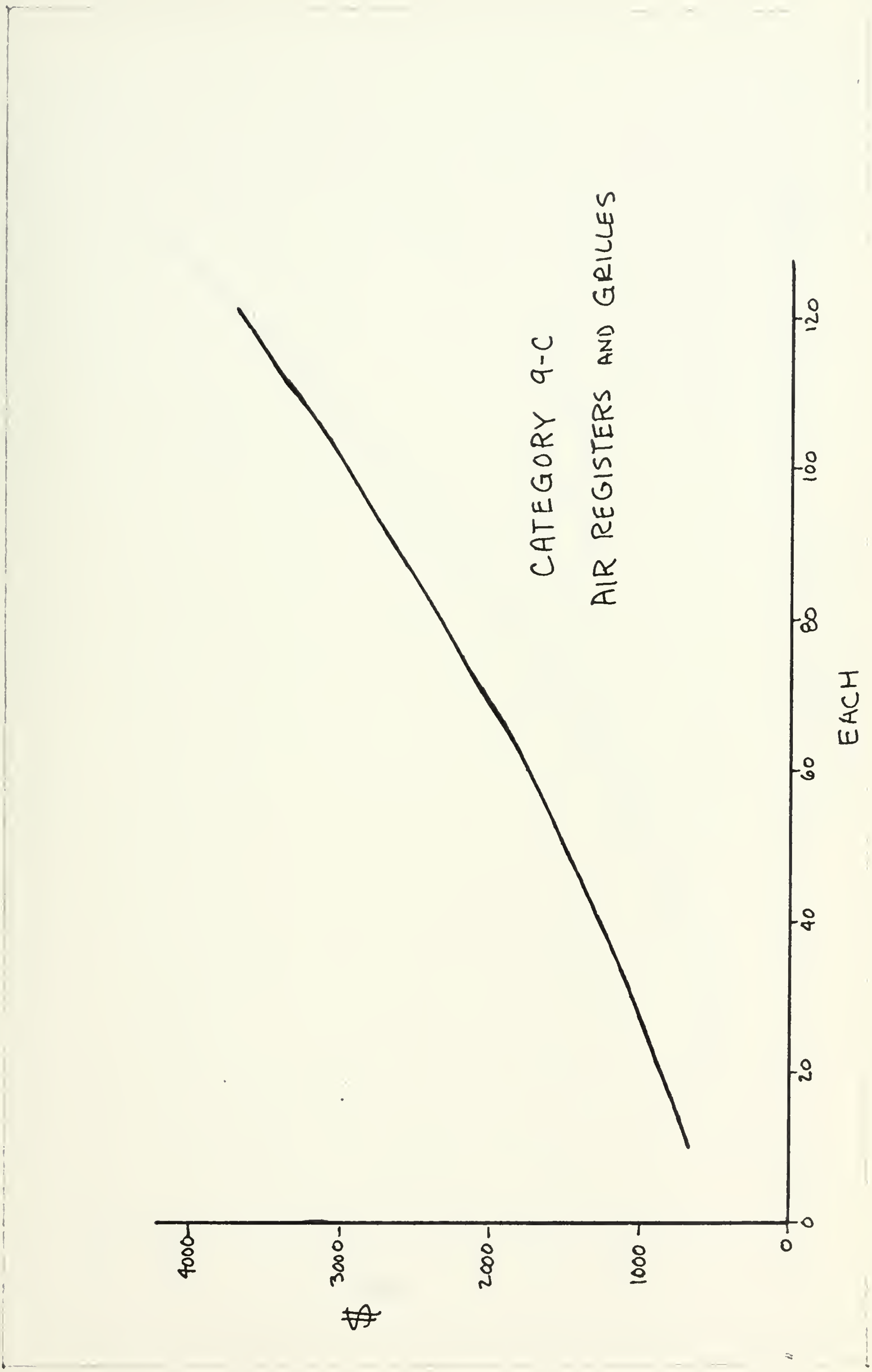

CATEGORY 8-F
PVC (POLYVINYL CHLORIDE) PIPE
4-8 INCHES
LINEAR FEET
$
0
400
800
1200
1600
1000
2000
3000
4000
5000
6000
7000

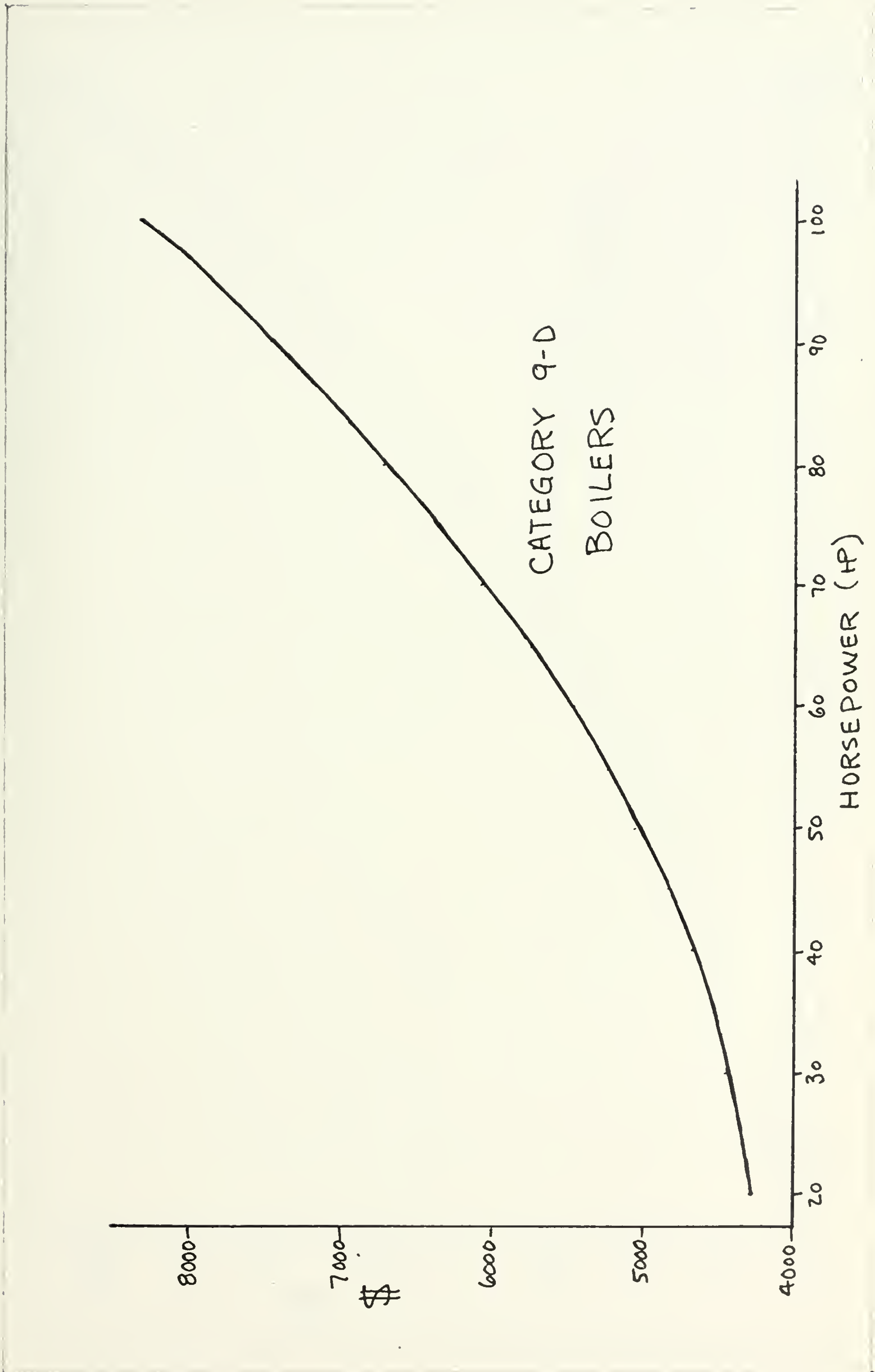

CATEGORY 8-G
IRON OR STEEL PIPE
½ - 1 INCH
LINEAR FEET
$
0
400
800
1200
1600
0
1000
2000
3000
4000

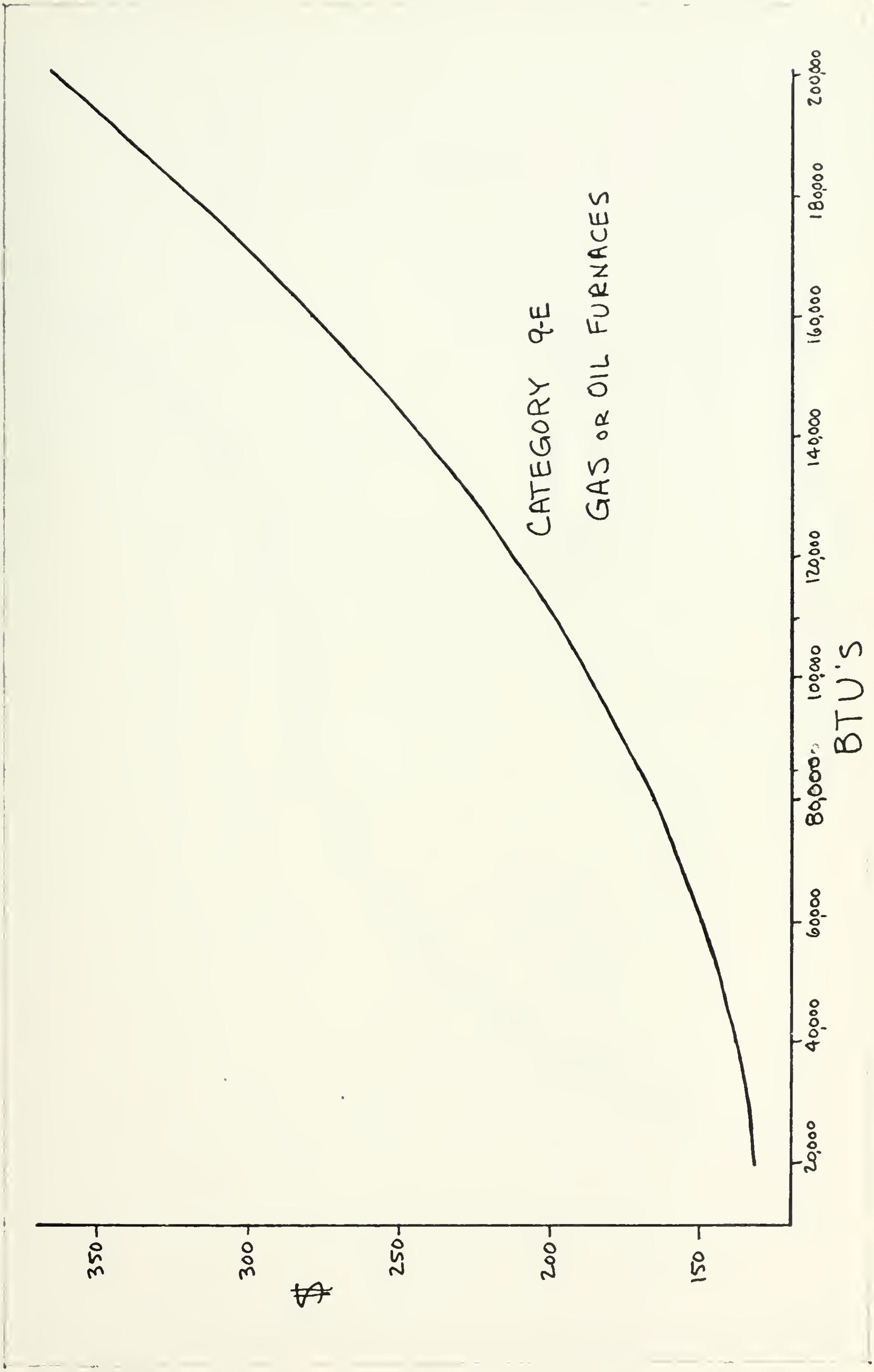

CATEGORY 8-H
IRON OR STEEL PIPE
1¼ - 4 INCH
$
4000
3000
2000
1000
0
0
200
400
600
800
LINEAR FEET

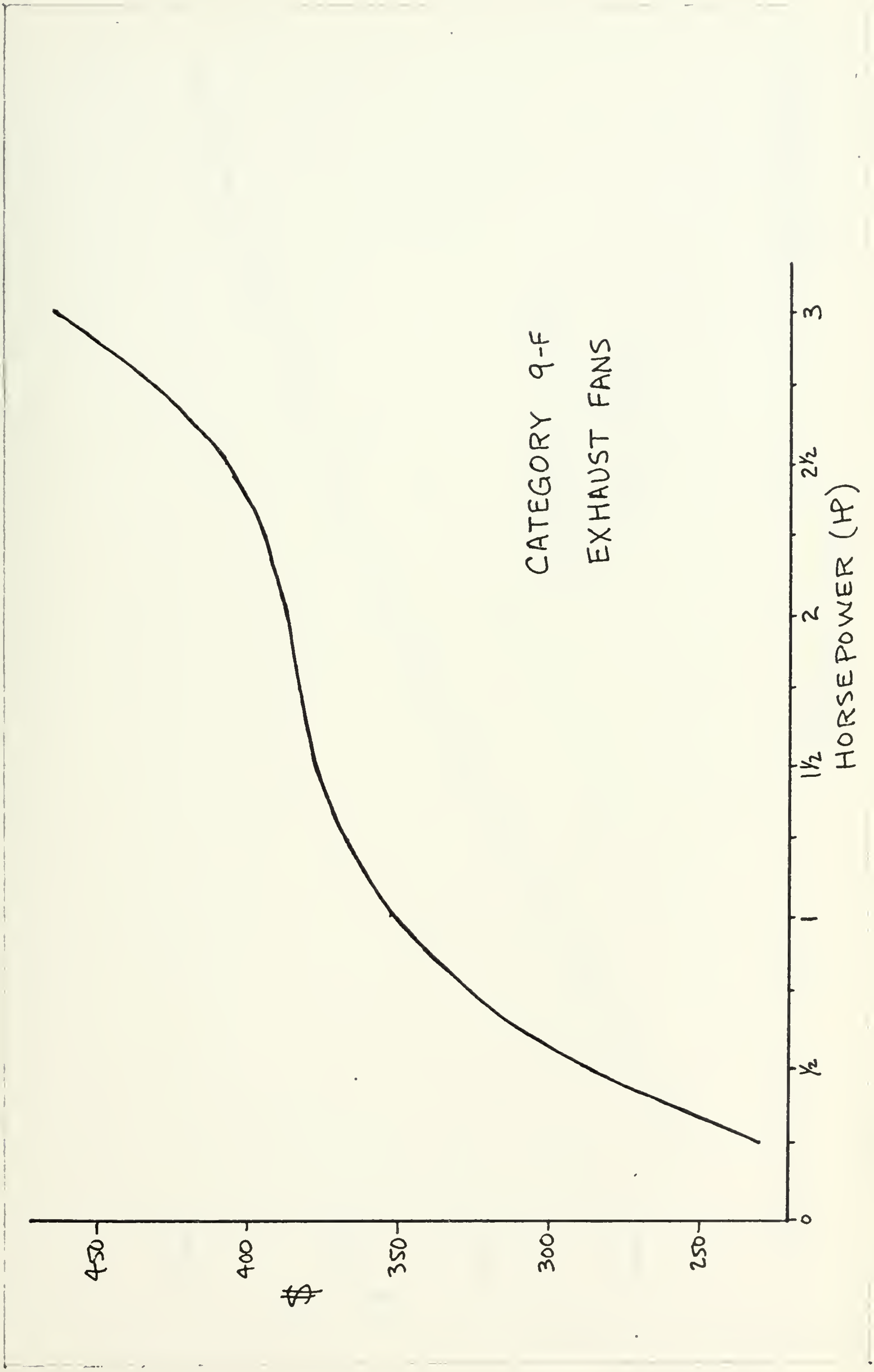

CATEGORY 9-A
AIR CONDITIONING EQUIPMENT
TONS OF COOLING
6
12
18
24
30
36
42
48
$
1000
2000
3000
4000
5000
6000
7000

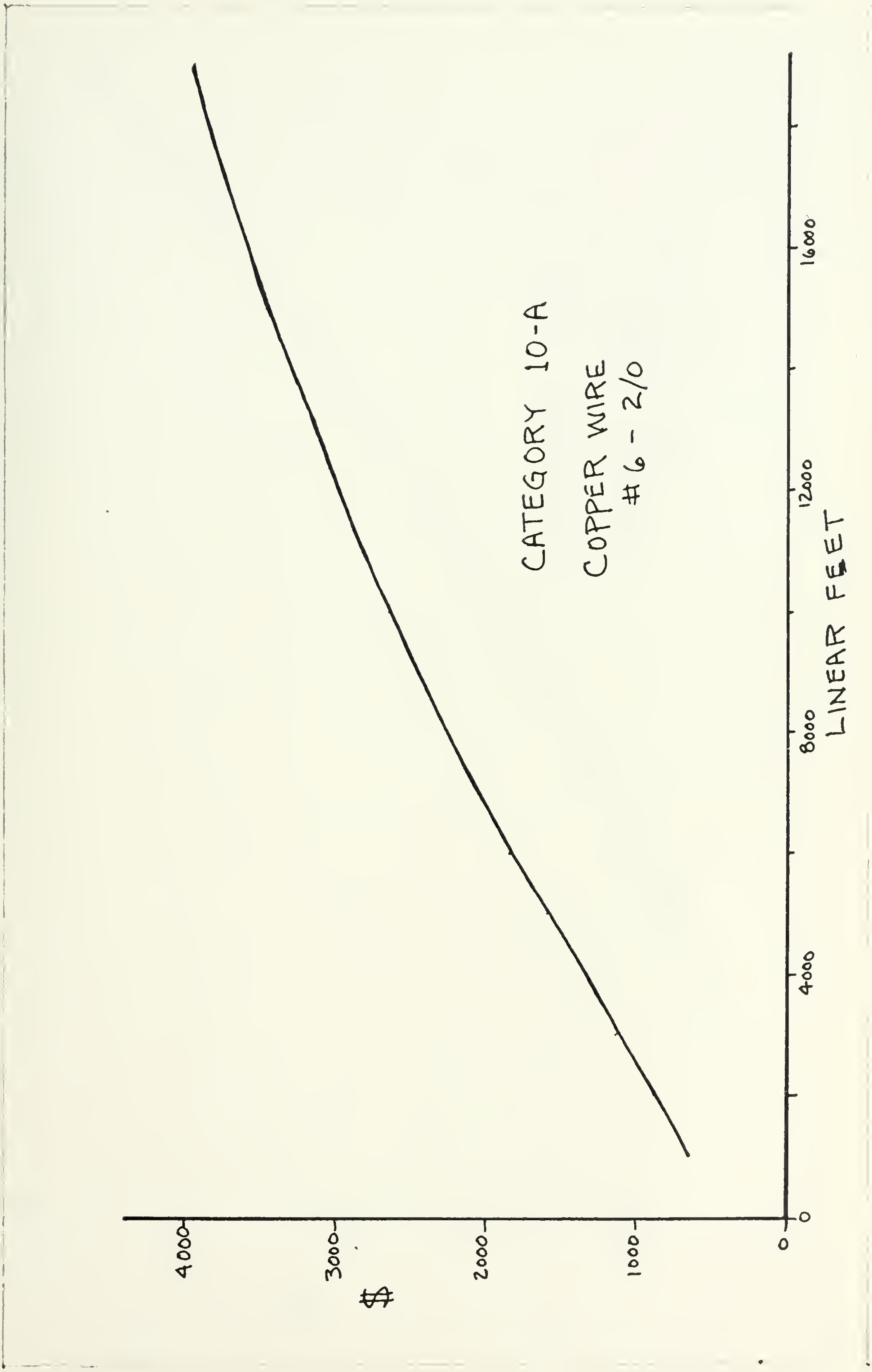

6000
5000
4000
3000
2000
$
0
1000
2000
3000
4000
5000
6000
POUNDS
CATEGORY 9-B
INSULATED DUCTWORK

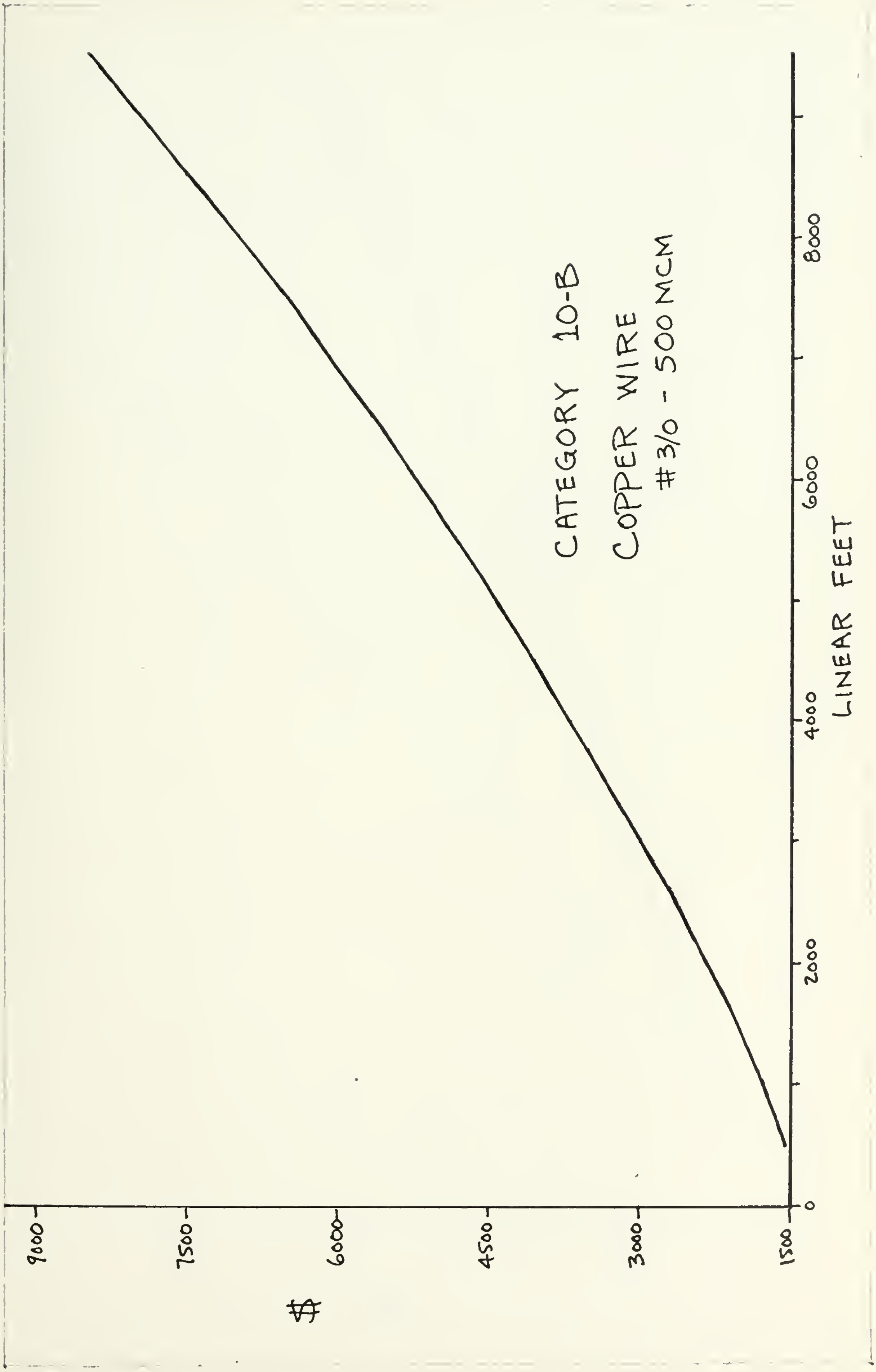

CATEGORY 9-C
AIR REGISTERS AND GRILLES
EACH
0
20
40
60
80
100
120
$
0
1000
2000
3000
4000

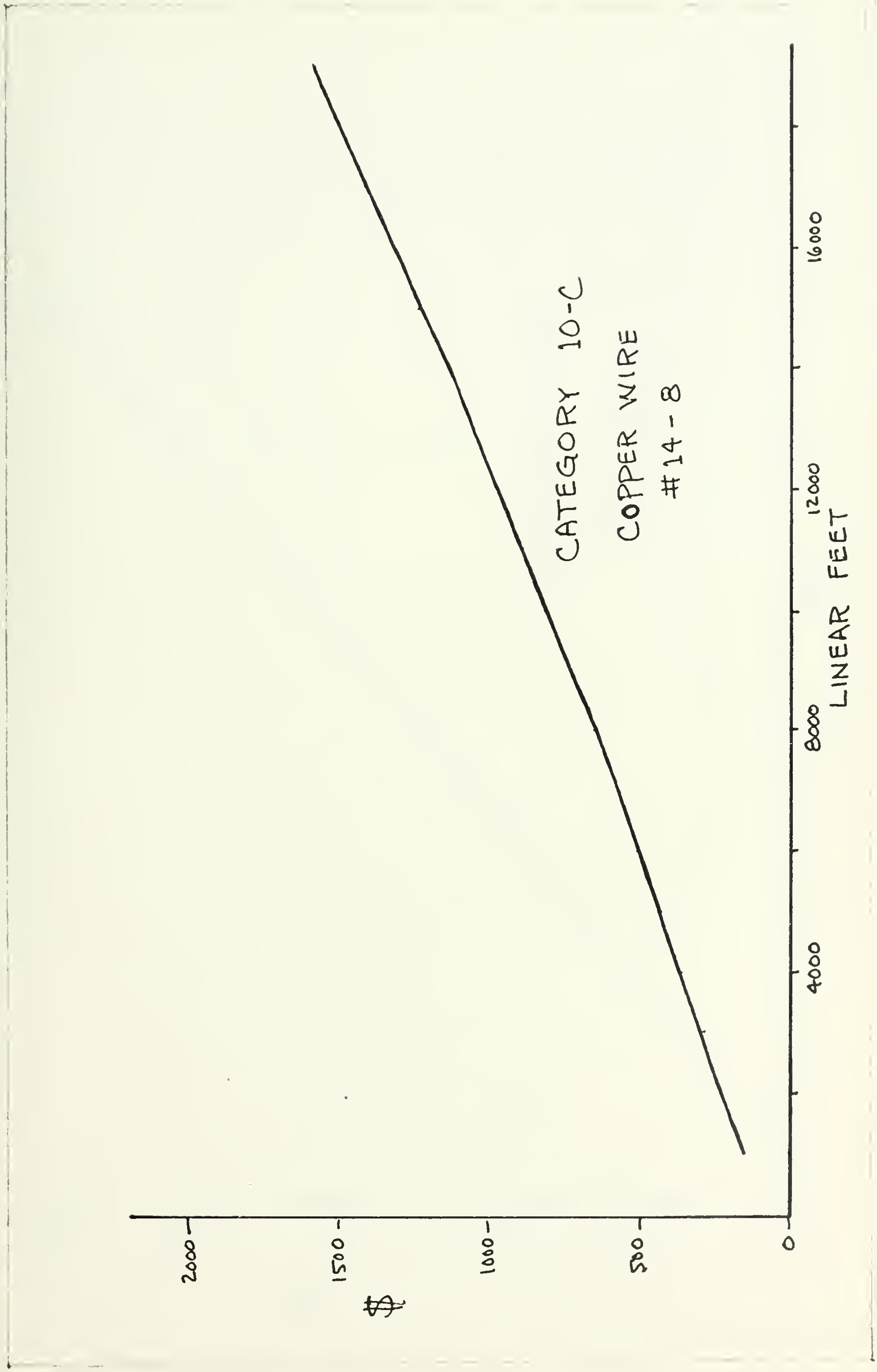

CATEGORY 9-D
BOILERS
HORSEPOWER (HP)
$
4000
5000
6000
7000
8000
20
30
40
50
60
70
80
90
100

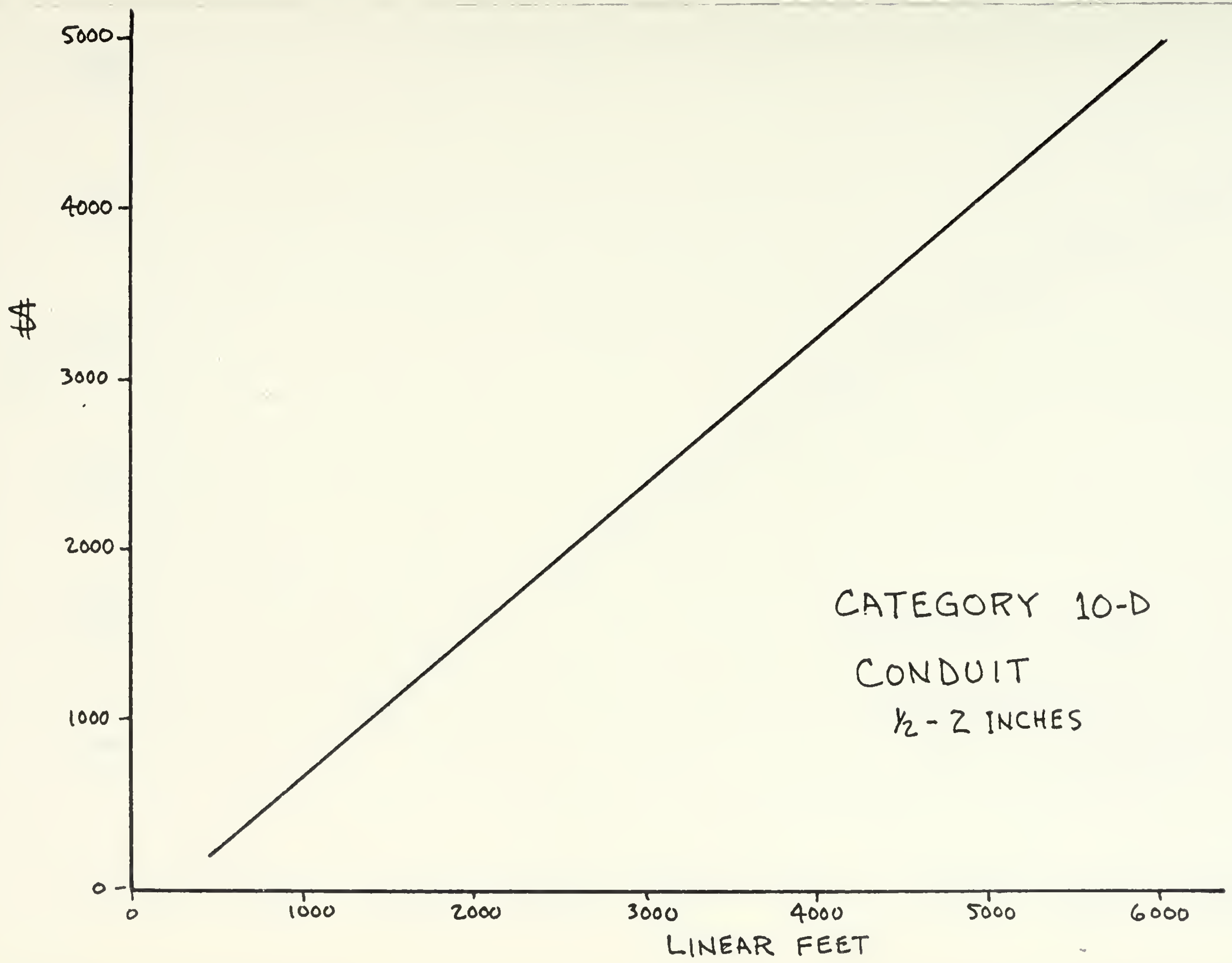

CATEGORY 9-E
GAS OR OIL FURNACES
BTU'S
$
350
300
250
200
150
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000


CATEGORY 9-F
EXHAUST FANS
HORSEPOWER (HP)
0
½
1
1½
2
2½
3
$
450
400
350
300
250

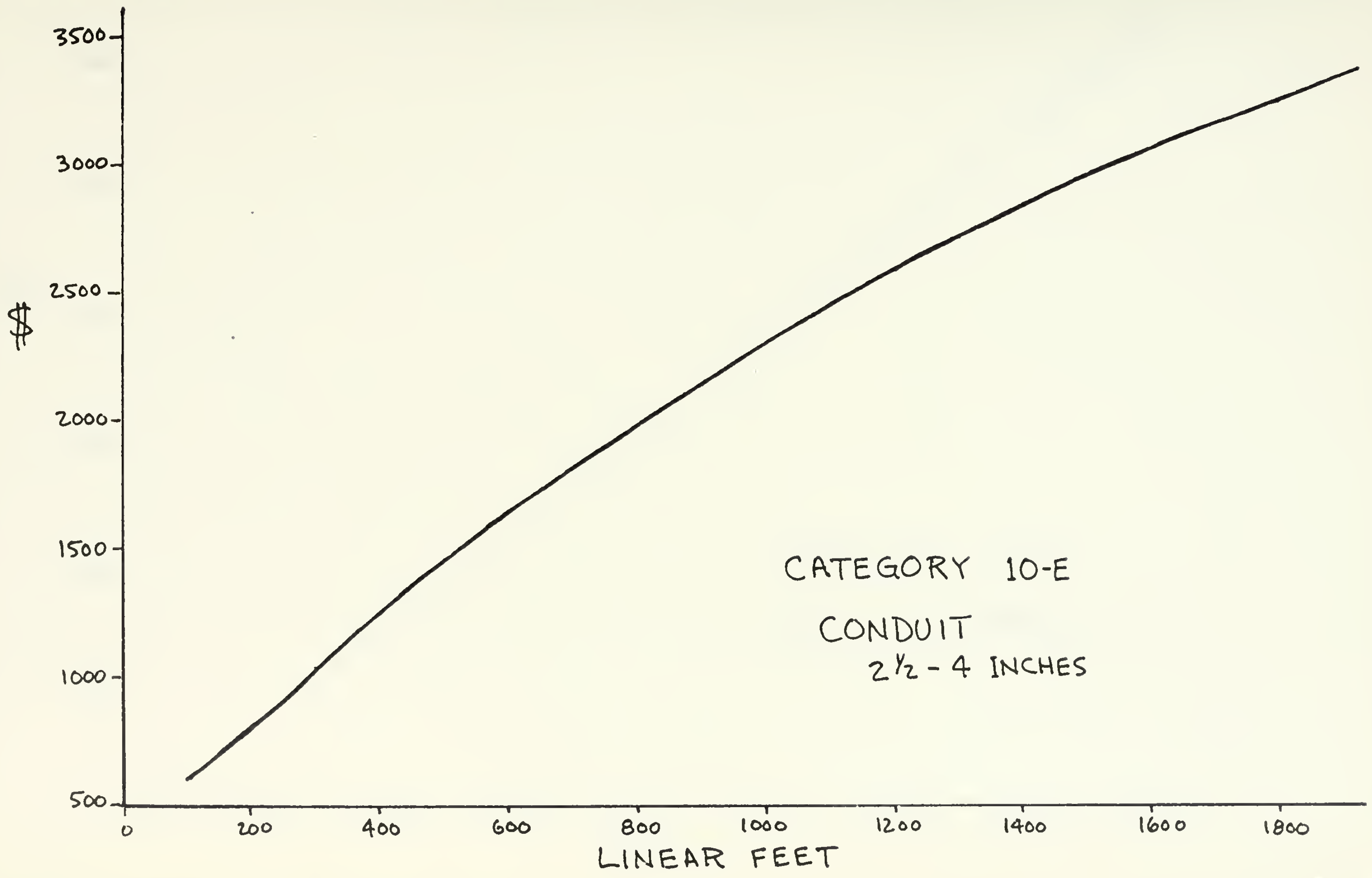

CATEGORY 10-A
COPPER WIRE
#6 - 2/0
LINEAR FEET
$
0
1000
2000
3000
4000
0
4000
8000
12000
16000

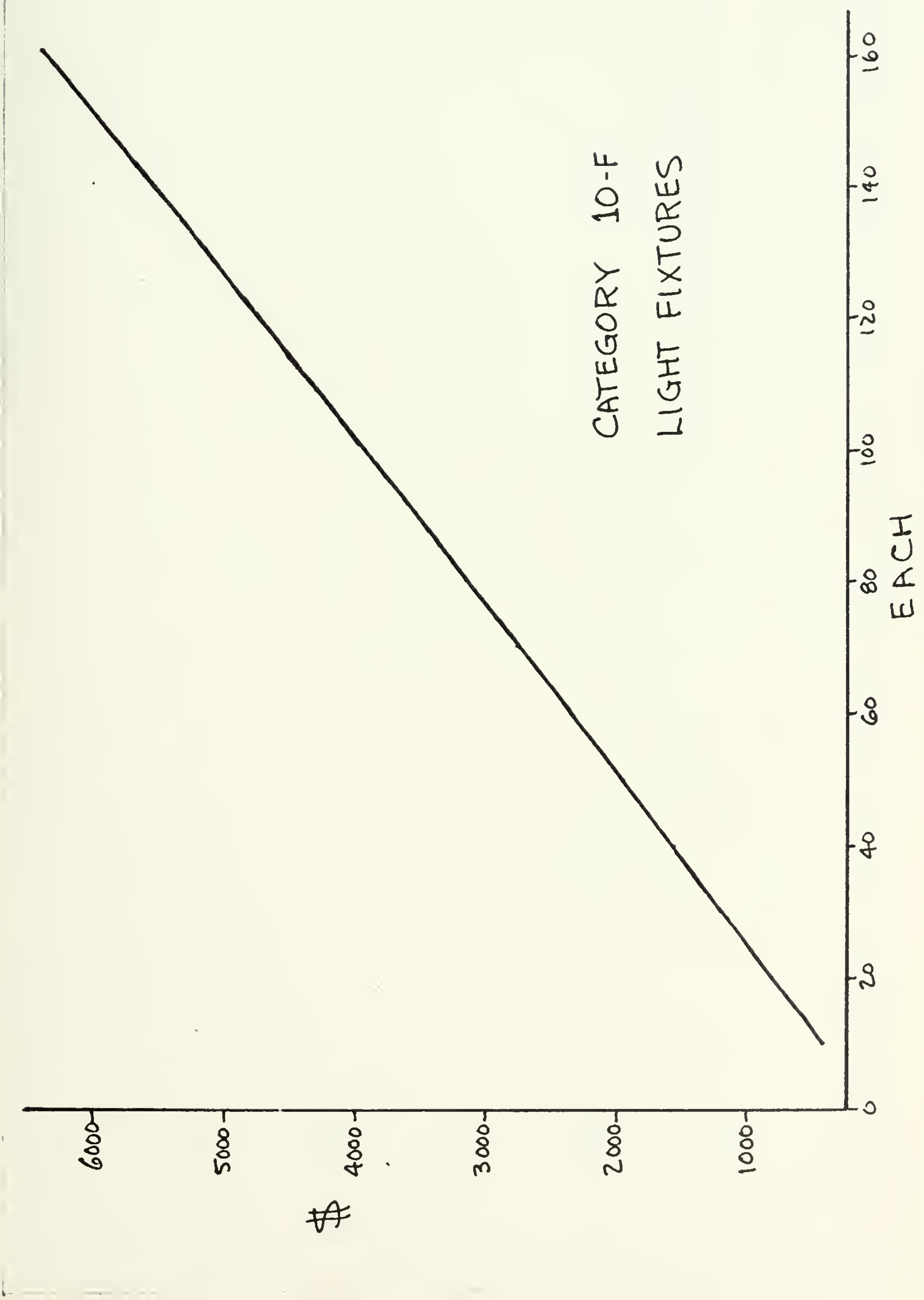

CATEGORY 10-B
COPPER WIRE
#3/0 - 500 MCM
LINEAR FEET
$
0
2000
4000
6000
8000
1500
3000
4500
6000
7500
9000

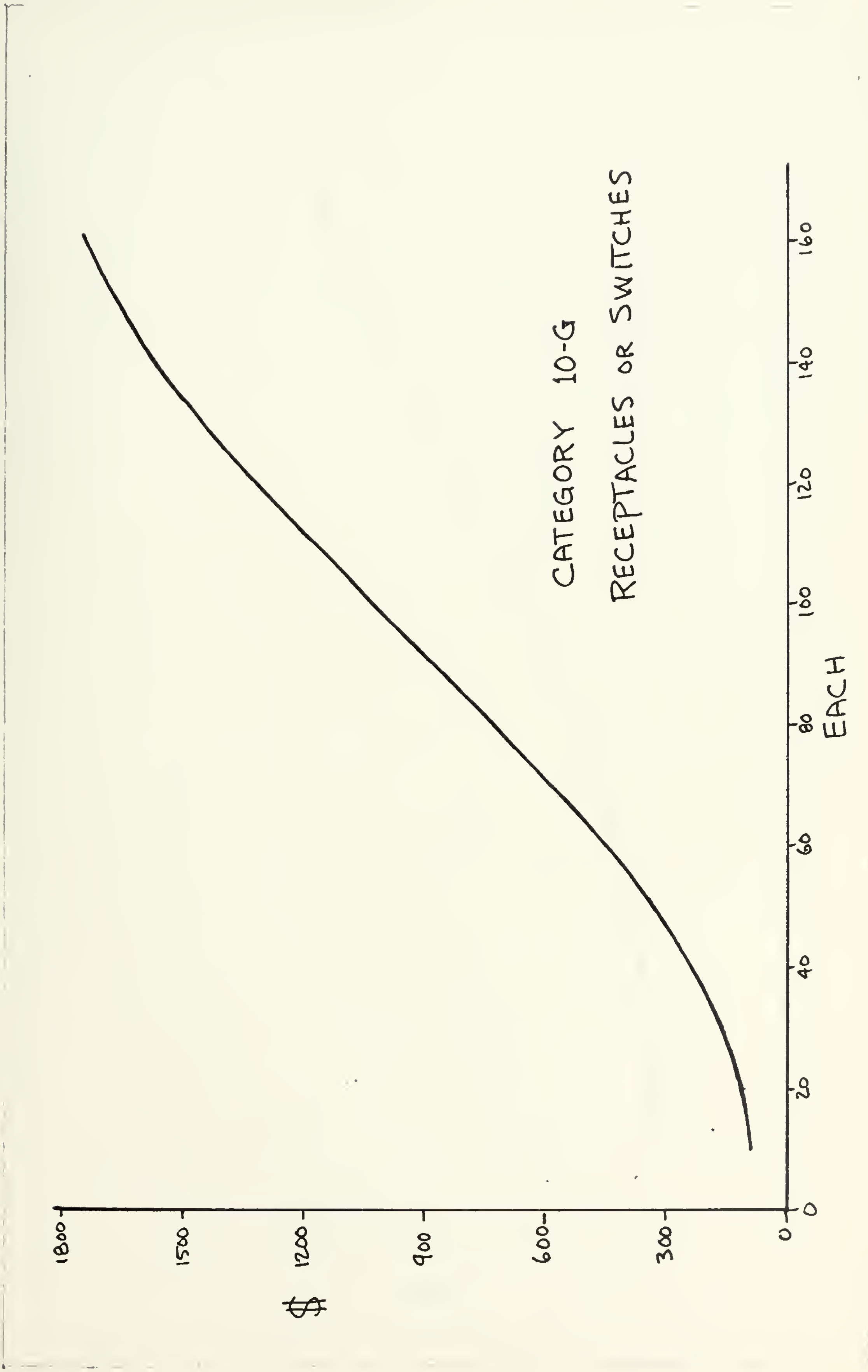

CATEGORY 10-C
COPPER WIRE
#14 - 8
LINEAR FEET
$
0
500
1000
1500
2000
4000
8000
12000
16000

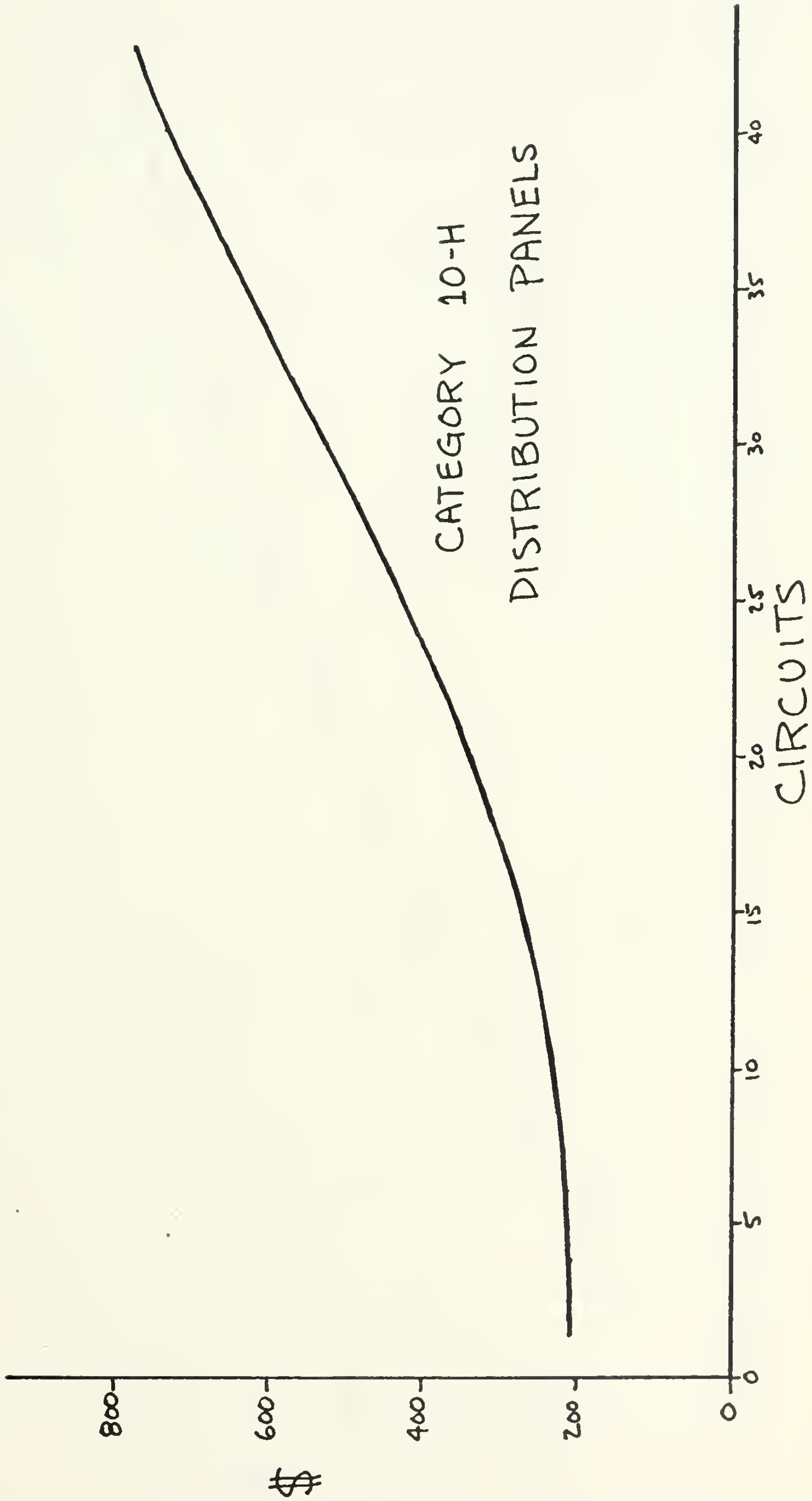


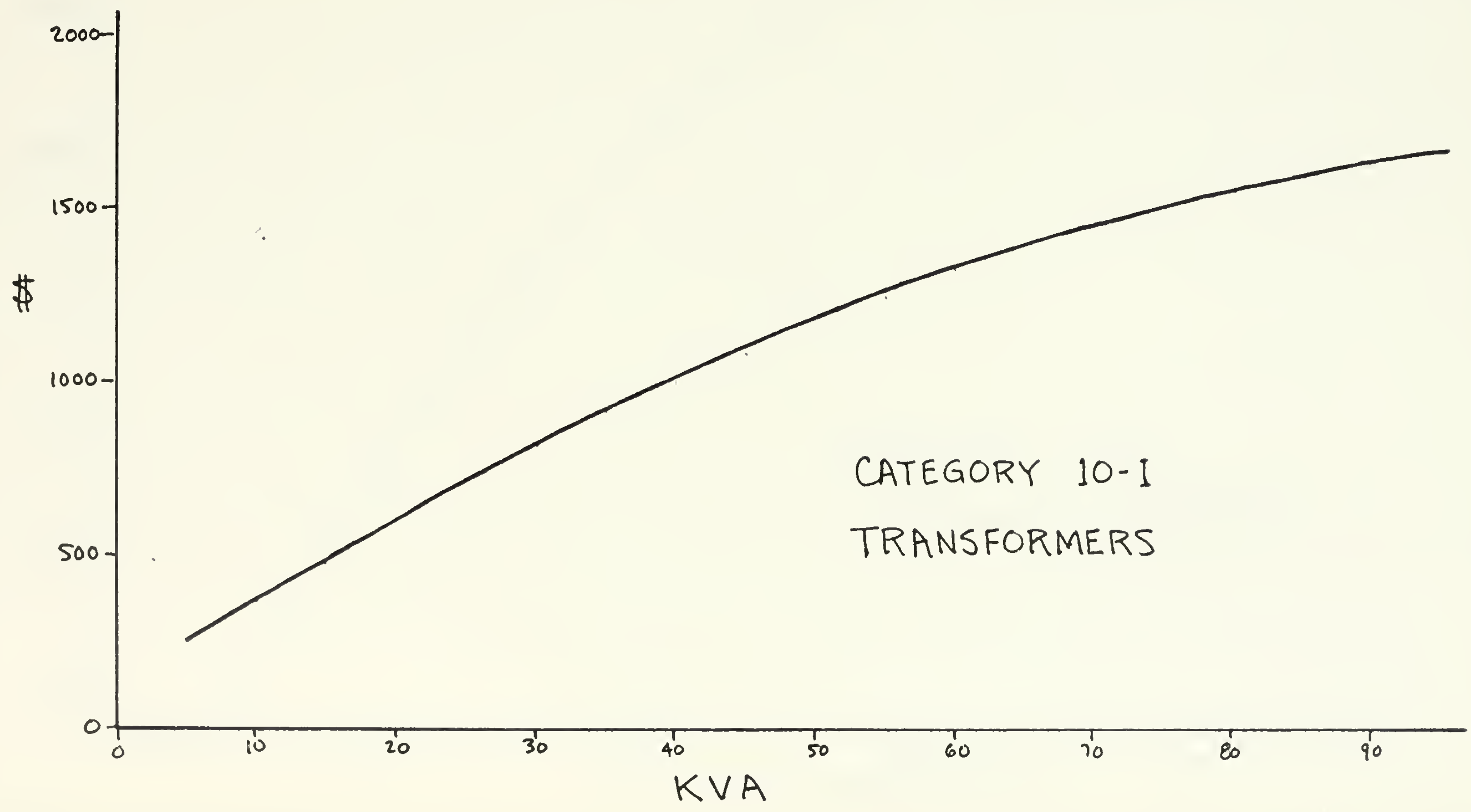
CATEGORY 10-D
CONDUIT
½ - 2 INCHES
$
0
1000
2000
3000
4000
5000
6000
LINEAR FEET

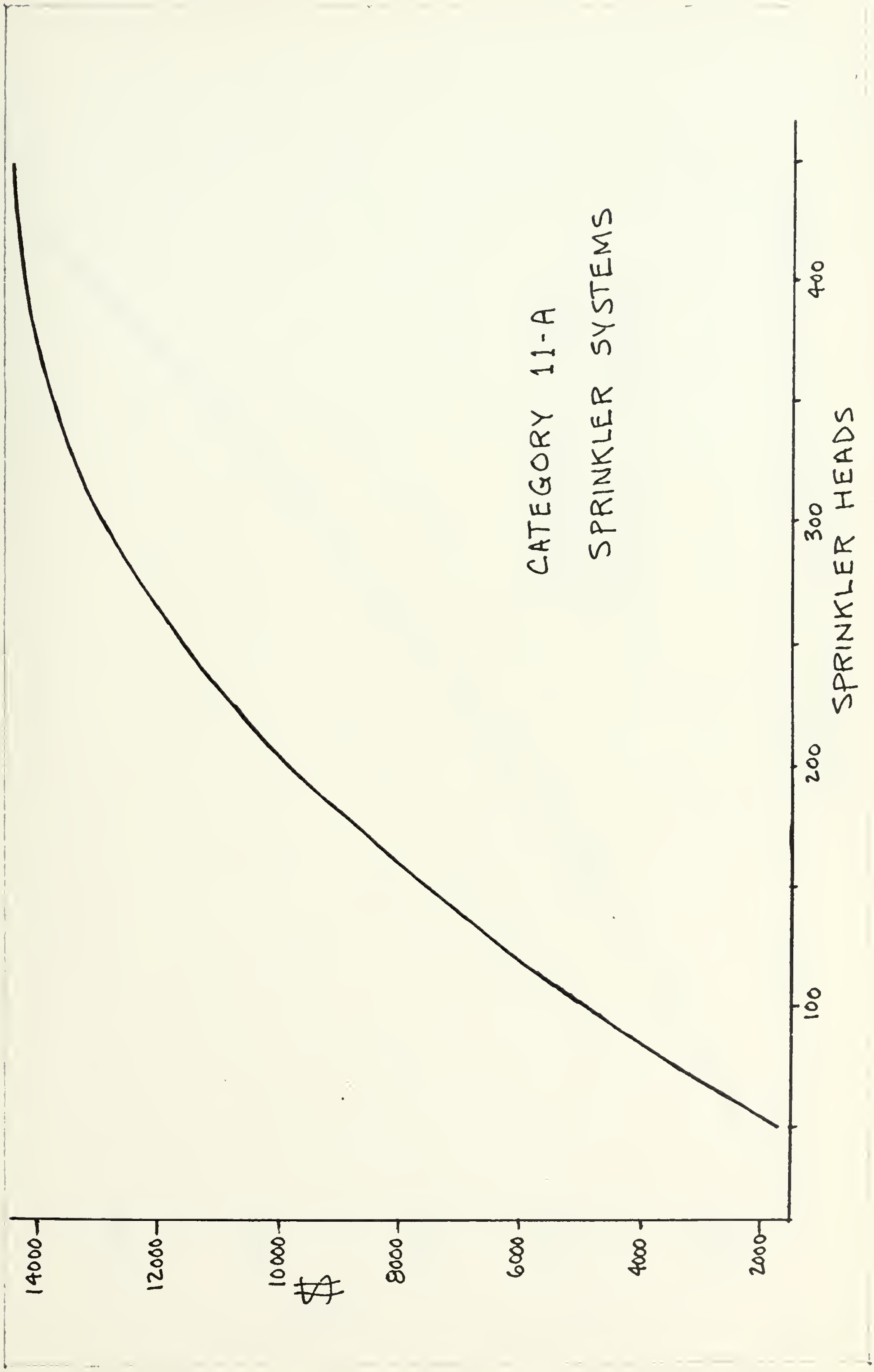

3500
3000
2500
2000
1500
1000
500
$
0
200
400
600
800
1000
1200
1400
1600
1800
LINEAR FEET
CATEGORY 10-E
CONDUIT
2½ - 4 INCHES

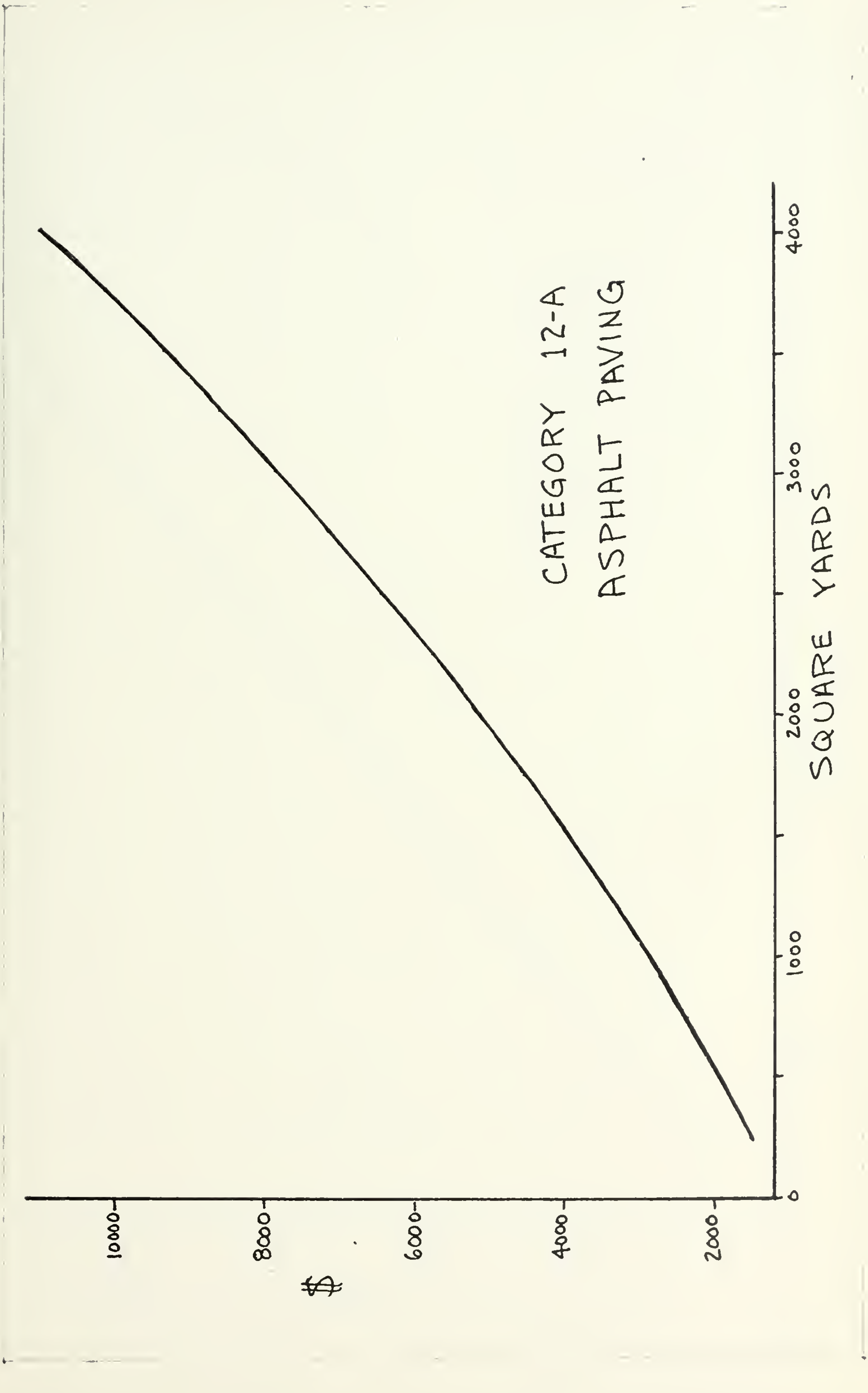

CATEGORY 10-F
LIGHT FIXTURES
EACH
$
0
20
40
60
80
100
120
140
160
1000
2000
3000
4000
5000
6000

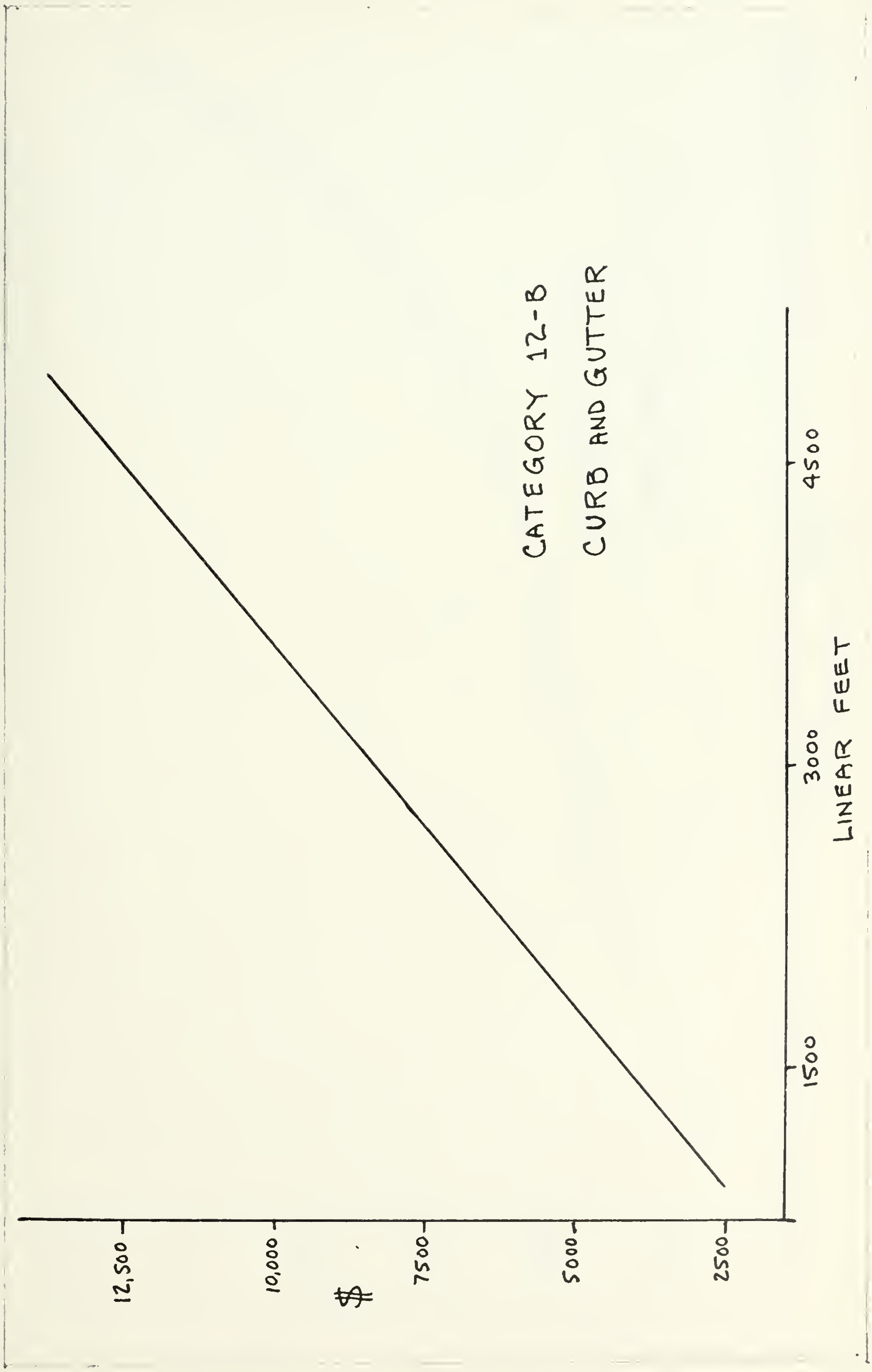

CATEGORY 10-G
RECEPTACLES OR SWITCHES
EACH
$
0
20
40
60
80
100
120
140
160
300
600
900
1200
1500
1800

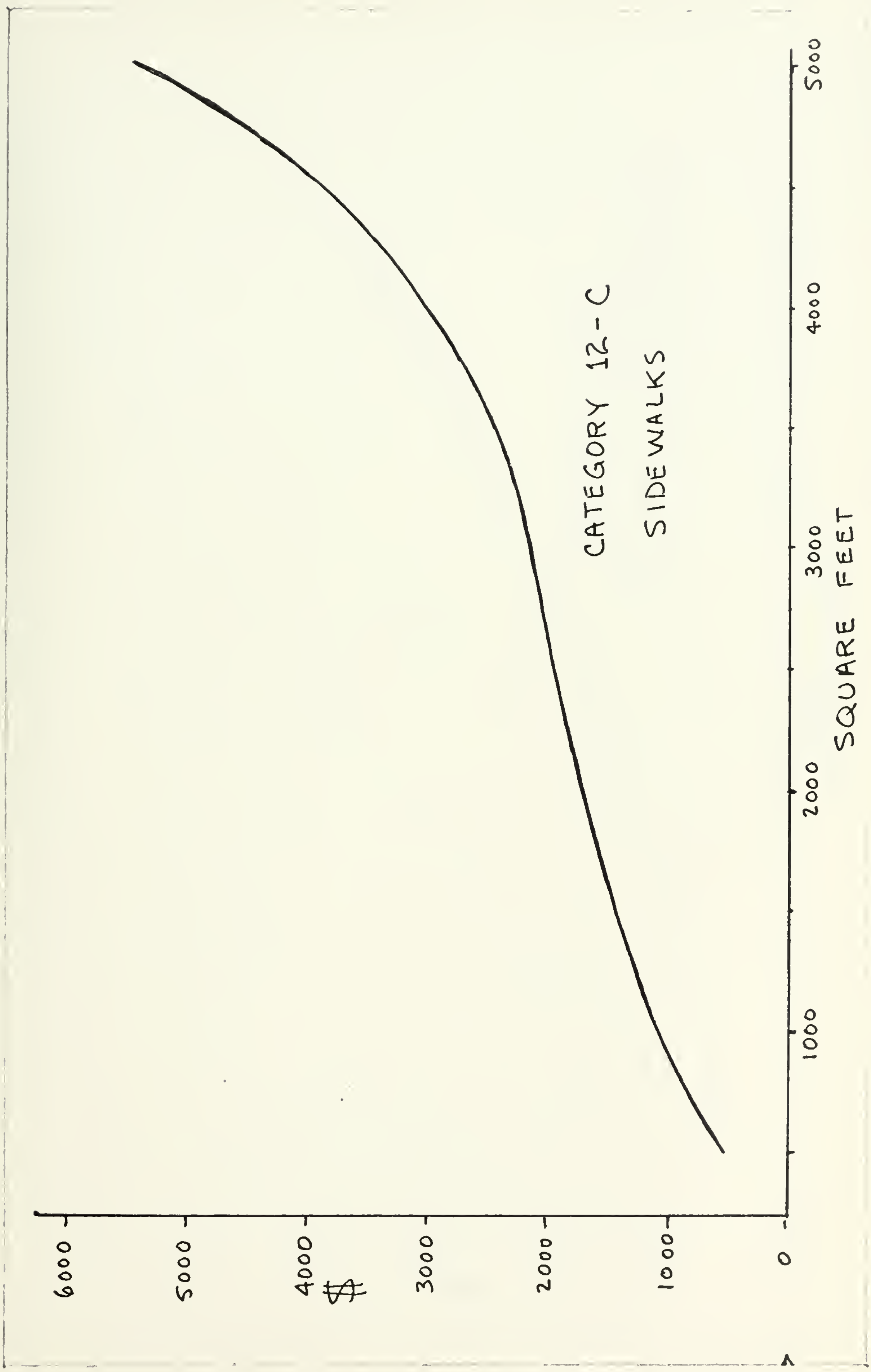

CATEGORY 10-H
DISTRIBUTION PANELS
CIRCUITS
$
0
200
400
600
800
0
5
10
15
20
25
30
35
40

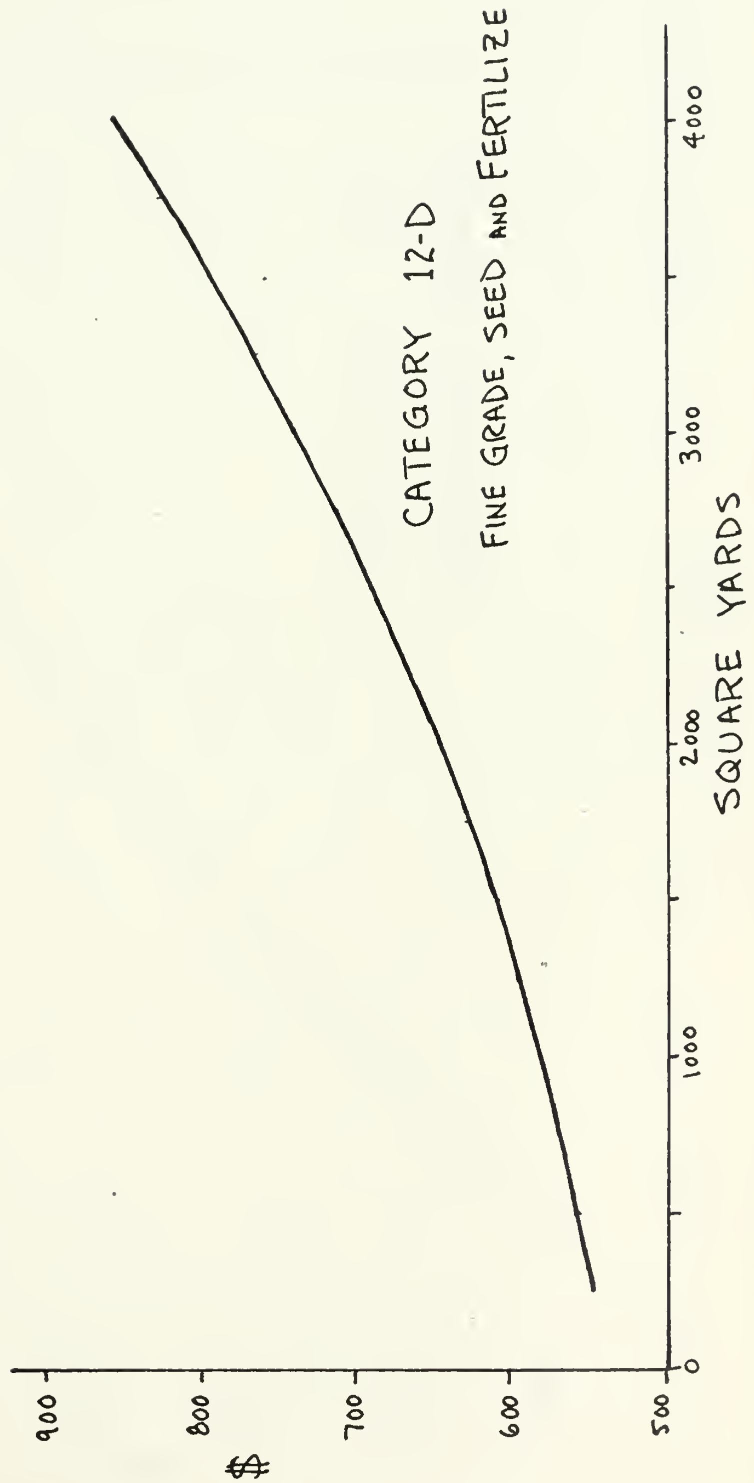

CATEGORY 10-I
TRANSFORMERS
$
2000
1500
1000
500
0
0
10
20
30
40
50
60
70
80
90
KVA

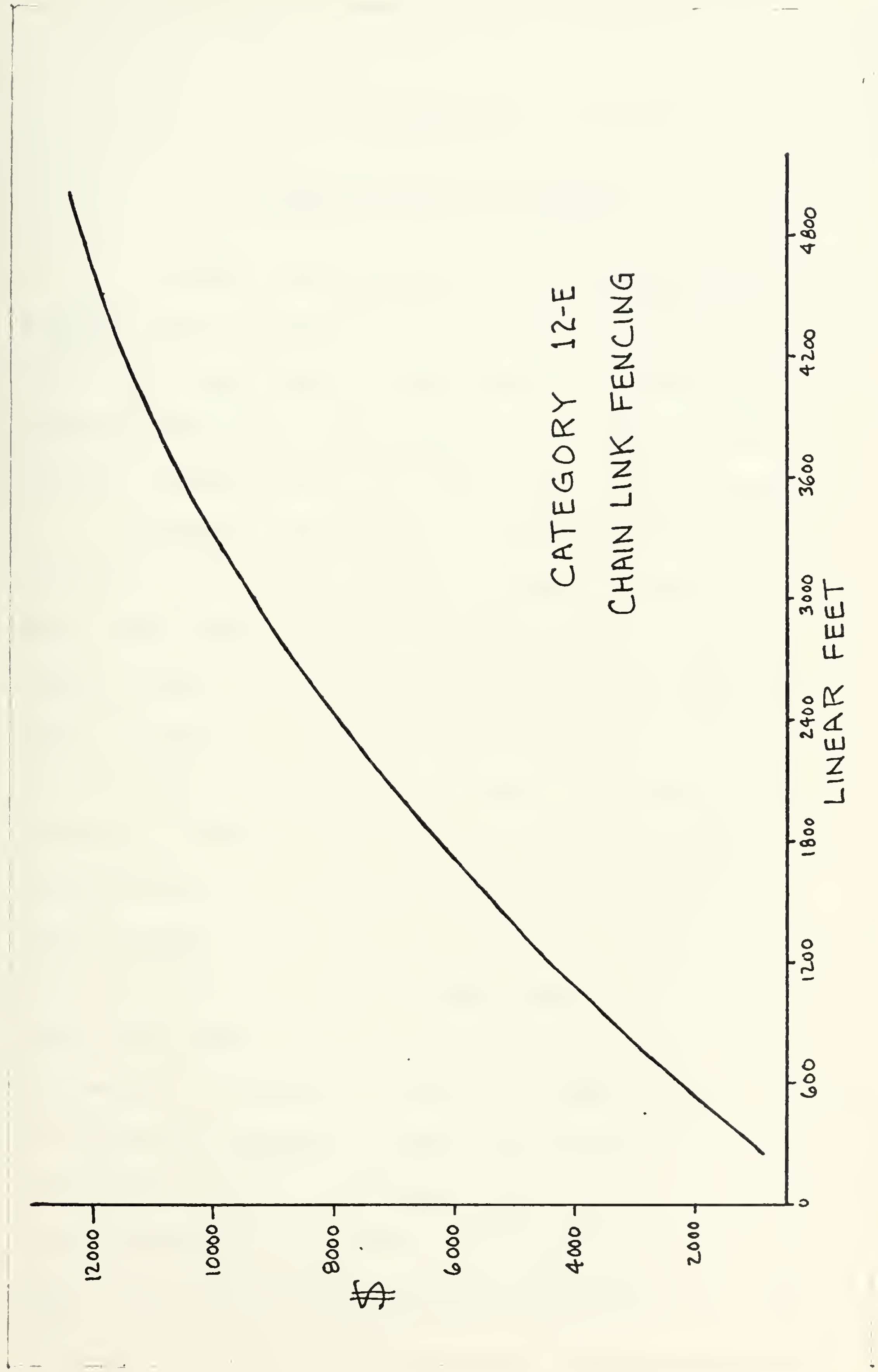

CATEGORY 11-A
SPRINKLER SYSTEMS
SPRINKLER HEADS
100
200
300
400
$
2000
4000
6000
8000
10000
12000
14000


CATEGORY 12-A
ASPHALT PAVING
SQUARE YARDS
$
0
1000
2000
3000
4000
2000
4000
6000
8000
10000


CATEGORY 12-B
CURB AND GUTTER
$
12,500
10,000
7500
5000
2500
1500
3000
4500
LINEAR FEET


CATEGORY 12-C
SIDEWALKS
SQUARE FEET
$
0
1000
2000
3000
4000
5000
6000
1000
2000
3000
4000
5000


CATEGORY 12-D
FINE GRADE, SEED AND FERTILIZE
SQUARE YARDS
$
0
1000
2000
3000
4000
500
600
700
800
900


CATEGORY 12-E
CHAIN LINK FENCING
LINEAR FEET
$
0
600
1200
1800
2400
3000
3600
4200
4800
2000
4000
6000
8000
10000
12000

APPENDIX C

SAMPLE PROJECT ESTIMATES

To test the reliability of the estimating system proposed cost estimates for four of the simpler projects from which base data was drawn were prepared using the system guidelines. The schedules of prices and the system estimate are provided and the values compared.

Results varied from a +41% to a -12% of the actual low bid on the project. However, when the estimates were compared with the next bidder's price and the range of bids the deviations in costs were relatively small. Further, as the project information provided gave no indication of the government estimate or the keenness of the bidding competition, it is difficult to ascertain whether the successful bid was within the profit ranges expected in a competitive environment. As shown in the estimates for these projects, certain minor adjustments to categories must be made at the discretion of the user to adapt to local projects. Since the items and categories indicated are based on broad information to allow universal application, known deviations and additional items must be adjusted for accordingly. The system was developed for projects in the

range up to $200,000; the projects tested fell in the first 10% of that range. It is expected that estimates for projects of a higher value will exhibit a more accurate results.

Crane, Indiana — Use City #6

Nov. 1972 (1.29)

Category	Item	Units	Base Cost		
8	A.C. Pipe	550 LF	2800		
8	Curb Inlets*	3	600		
			3400	x 1.00 =	3400
1	Excavation**	370 CY	1800		
1	Top Soil ***	270 CY	540		
			2340	x 1.04 =	2434
12	Sidewalk	955 SF	1000		
12	Curb and Gutter	410 LF	1200		
			2200	x 1.11 =	2442
					8608

8608 x 1.29 x 1.25 = $13,880

* Use ½ manholes

** Use 1/3 compacted fill

*** 270 + 2 (50) (Rock) = 370 CY

Highest Bid = $21,250

Second Bid = $16,680

Low Bid = $10,777

$$\frac{\text{Estimate}}{\text{Actual}} = \frac{13{,}880}{10{,}777} = 1.2\overline{9}$$

Estimate is 29% above actual low bid

but only $\frac{13{,}880}{16{,}680}$ = .83 or 17% below second bid.

2. TITLE OF CONTRACT AND SITE LOCATION

Contract [illegible], Curbs & Sidewalks for Bldg. 2930 [illegible]

3. NAME AND ADDRESS OF CONTRACTOR

[illegible] Meridian Street, [illegible] 47501

4. CONTRACT NBY	5. DATE OF CONTRACT	6. CONTRACT PRICE	7. 2ND LOW BID*	8. HIGH BID*	9. NO. OF BIDDERS*
N62472-73-C-6026	[illegible]	[illegible]	16,680	21,250	4

10. ALLOTMENT OR ALLOCATION NO.	11. APPROPRIATION TITLE
	EXHIBIT C-1

12. TIME FOR COMPLETION (Days)	13. SIGNATURE AND TITLE OF CONTRACTOR'S AGENT
1 March 1973	Don D. Yates (OWNER)

14. REVIEWED & FORWARDED (Date)	15. SIGNATURE OF APPROVING OICC
22 Nov 1972	J. M. BANNISTER, CDR, CEC, USN

16.

a. ITEM NO.	b. DESCRIPTION OF ITEM	c. QUANTITIES: NO. OF UNITS	c. QUANTITIES: UNIT	d. MATERIAL COST: UNIT COST	d. MATERIAL COST: COST	e. LABOR COST: UNIT COST	e. LABOR COST: COST	f. TOTAL COST
1.	Storm Drain 15" [illegible]	[illegible]	[illegible]	[illegible].00	[illegible]	3.00	[illegible]	[illegible]
2.	[illegible]	[illegible]	[illegible]	1.90	437.00	2.10	[illegible]	[illegible]
3.	6" [illegible]	[illegible]	[illegible]	1.50	240.00	1.50	240.00	[illegible]
4.	Curb Inlets	3	ea.	[illegible]00.00	600.00	200.00	600.00	$1,200.00
5.	Excavation	[illegible]	cu. yds.			1.50	455.0[illegible]	[illegible]
6.	Top Soil [illegible]	[illegible]	cu. yds.			2.00	540.[illegible]	[illegible]
7.	Reinforced Curb & Gutter	[illegible]	[illegible]	2.50	1025.00	2.25	922.50	$1,947.50
8.	4" Sidewalk	[illegible]	sq. ft.	.32	625.60	.68	1329.40	$1,955.00
9.	Rock Excavation	5[illegible]	cu. yds.			39.99	[illegible]	[illegible]

Corpus Christi, Texas — Use City # 8
Dec. 1970 (1.10)

Category	Item	Units	Base Cost		
5	Roofing Removal	522 sq	7250		
5	Shingle Roof	522 sq	8700		
			15950	x .89 =	14195
4	Insulation	52,200 SF*	4000	x .79 =	3160
9	Sheet metal gutters and edging	2000 LF**	2250	x .90 =	2015
					19370

19370 x 1.10 x 1.25 = 26,635

* Extrapolate curve, assume constant scope
** Use sheel metal duct, assume 3/4 lb/ft.

Highest Bid = $38,000

Second Bid = $31,116

Low Bid = $28,884

$$\frac{\text{Estimate}}{\text{Actual}} = \frac{26,635}{28,884} = 0.9\overline{2}$$

Estimate is 8% below actual low bid.

EXHIBIT C-2

1. ACTIVITY AND LOCATION
Naval Air Station, Corpus Christi, Texas

2. TITLE OF CONTRACT AND SITE LOCATION
Roof Repairs, Building 258 at Naval Air Station, Corpus Christi, Texas

3. NAME AND ADDRESS OF CONTRACTOR,
Guaranteed Repair Contractors, 2742 South Padre Island Drive, Corpus Christi, Texas

4. CONTRACT NBY	5. DATE OF CONTRACT	6. CONTRACT PRICE	7. 2ND LOW BID*	8. HIGH BID*	9. NO. OF BIDDERS*
N62467-71-C-1449	21 Dec 70	$28,884.00	$31,116.00	$38,000.00	4

10. ALLOTMENT OR ALLOCATION NO.	11. APPROPRIATION TITLE
00025/C	1711804.2576

12. TIME FOR COMPLETION (Days)	13. SIGNATURE AND TITLE OF CONTRACTOR'S AGENT
45	

14. REVIEWED & FORWARDED (Date)	15. SIGNATURE OF APPROVING OICC
27 January 1971	T. R. HORTON, By direction of the OICC Supv. Civil Engineer

16.

a. ITEM NO.	b. DESCRIPTION OF ITEM	c. QUANTITIES		d. MATERIAL COST		e. LABOR COST		f. TOTAL COST
		NO. OF UNITS	UNIT	UNIT COST	COST	UNIT COST	COST	
	Roof removal and nail 30# base	522	sq.			$10.00	$5220.00	$ 5,220.00
	Roof Insulation Mopped Down	522	sq.	$9.00	$4698.00	$11.00	$5742.00	$10,440.00
	1 30# and three 15# asbestos felts Mopped on and flooded.	522	sq.	$11.00	$5742.00	$ 8.35	$4358.00	$10,100.00
	Metal Edge	1200	L.F.	$ .15	$ 180.00	$ .60	$ 720.00	$ 900.00
	Flashing	56	L.F.	$ 2.00	$ 112.00	$ 2.00	$ 112.00	$ 224.00
	Gutters	1000	L.F.	$ .80	$ 800.00	$ 1.20	$1200.00	$ 2,000.00

Memphis, Tenn.
Jun 72 (1.254)

Use City #1

Category	Item	Units	Base Cost		
5	Removal	189 sq	3100		
5	Shingle Roof	189 sq	5700		
			8800	x .88 =	7744
2	Wood Decking	2000 bdft	870		
2	Wood Joists	1000 bdft	510		
			1380	x .89 =	1228
					8972

8972 x 1.254 x 1.25 = $14,063

Highest Bid = $61,198

Second Bid = $16,007

Low Bid = $9,988

$$\frac{\text{Estimate}}{\text{Actual}} = \frac{14,063}{9,988} = 1.41$$

Estimate is 41% above actual low bid,

but only $\frac{14,063}{16,007}$ = .88 or 12% below second bid.

1. ACTIVITY AND LOCATION
Officer in Charge of Construction, Naval Air Station Memphis, Millington, Tennessee

2. TITLE OF CONTRACT AND SITE LOCATION
Replacement of Roofing Over Commissary Store, N-91, Naval Air Station Memphis/Millington, Tennessee

3. NAME AND ADDRESS OF CONTRACTOR
Dennies Contracting Co., Inc.; 2601 Frisco Avenue; Memphis, Tennessee 38114

4. CONTRACT NBR	5. DATE OF CONTRACT	6. CONTRACT PRICE	7. 2ND LOW BID*	8. HIGH BID*	9. NO. OF BIDDERS*
N62467-72-C-6622	22 Jun 72	$9,988.00	$16,007.00	$61,198.00	3

10. ALLOTMENT OR ALLOCATION NO.	11. APPROPRIATION TITLE
00639/0	1721804.6284
12. TIME FOR COMPLETION (Days)	13. SIGNATURE AND TITLE OF CONTRACTOR'S AGENT
60	President
14. REVIEWED & FORWARDED (Date)	15. SIGNATURE OF APPROVING OICC
10 JUL 1974	

16.

a. ITEM NO.	b. DESCRIPTION OF ITEM	c. QUANTITIES: NO. OF UNITS	c. QUANTITIES: UNIT	d. MATERIAL COST: UNIT COST	d. MATERIAL COST: COST	e. LABOR COST: UNIT COST	e. LABOR COST: COST	f. TOTAL COST
1	Remove & replace roofing	189	sqs	$21.74	$4,108.00	$20.00	$3,780.00	$7,888.00
2	Replace roof decking	2000	bd ft	.25	500.00	.45	900.00	1,400.00
3	Replace roof joists	1000	bd ft	.25	250.00	.45	450.00	700.00

EXHIBIT C-3

Philadelphia, Pa. Nov. 1972 (1.29)

Use City #16

Category	Item	Units	Base Cost	
5	Removal	130 sq	2250	
5	Built-up Roof	130 sq	5800	
			8050 x 1.02 =	8211
2	Wood Decking	250 bf	1200 x 1.05 =	1260
				9471

9471 x 1.29 x 1.25 = $15,272

High Bid = $35,268

Second Bid = $17,500

Low Bid = $17,420

$$\frac{\text{Estimate}}{\text{Actual}} = \frac{15{,}272}{17{,}420} = 0.8\overline{8}$$

Estimate is 12% below actual low bid.

[ACTIVI]TY AND LOCATION

Naval Base

[De]pt. of the Navy, Northern Division, Naval Facilities Engineering Command, Phila. Pa.

[T]ITLE OF CONTRACT AND SITE LOCATION

Roof Repairs at N & MC Center, Ft. Schuyler, New York

3. NAME AND ADDRESS OF CONTRACTOR

I. Alper Co. N. 6th St. at Dela. River, Camden, N. J. 08102

4. CONTRACT NBY	5. DATE OF CONTRACT	6. CONTRACT PRICE	7. 2ND LOW BID*	8. HIGH BID*	9. NO. OF BIDDERS*
N62472-73-C-0064	11-28-72	17,420.00	17,500	35,268	6

10. ALLOTMENT OR ALLOCATION NO.	11. APPROPRIATION TITLE
000067	1731804.6751
12. TIME FOR COMPLETION (Days)	**13. SIGNATURE AND TITLE OF CONTRACTOR'S AGENT**
120	Hyman Alper, Secretary-treasurer
REVIEWED & FORWARDED (Date)	**15. SIGNATURE OF APPROVING OICC**
12 Dec 72	

16.

a. ITEM NO.	b. DESCRIPTION OF ITEM	c. QUANTITIES: NO. OF UNITS	c. QUANTITIES: UNIT	d. MATERIAL COST: UNIT COST	d. MATERIAL COST: COST	e. LABOR COST: UNIT COST	e. LABOR COST: COST	f. TOTAL COST
1	Roofing-Tear Off	130	sq.	——	——	40.00	5,200.00	5,200.00
2	Roofing Installed	130	sq/	20.00	2,600.00	25.00	3,250.00	5,850.00
3	Slagging	130	sq.	10.00	1,300.00	20.00	2,600.00	3,900.00
4	Lumber	250	LF	1.00 Per M	250.00	3.00	750.00	1,000.00
5	Expansion Joint	120	LF	.50	60.00	5.00	600.00	660.00
6	Incidental Flashings		LUMP	SUM				710.00
7	Asphalt Fill		LUMP	SUM				100.00

EXHIBIT C-4

APPENDIX D

UPDATING THE SYSTEM

In order for this estimating system to remain a useful tool for the cost estimator, it is necessary that the Geographical and Projected Cost Factors be reviewed periodically. The base cost graphs are expected to remain valid for a considerable number of years.

The Geographical Factors should be reviewed annually by comparing the general city cost indexes cited in Chapter V with the current city cost indexes published by both the Engineering News Record and Mean's Building Construction Cost Data, or any of the other agencies that publish such data. If there is found to be any significant variance (2%) the City Cost Indexes should be adjusted accordingly. Similarly, the individual trade wages and material cost for each city should be compared with the national averages to determine whether there is any significant variances with the indexes calculated in this thesis. Adjustments can be made substituting new indexes for those given and proceeding in the method cited in Chapter VI to determine new city multipliers.

The Projected Cost Index as provided in Figure 5-2

can be readily adjusted by comparing the current cost indexes published by three or more of the agencies cited in Figure 5-1 with projections listed in the manner indicated in Chapter 5. This area is perhaps the most subject to variance as factors exterior to the categories cited affect the formulation of cost indexes. For this reason cost indexes should not be projected too far in advance.

144199

Thesis
G14054 Gallen
A model for providing preliminary cost estimates for minor public works projects.